Water policy and governance in Guyana, "the land of many waters"

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Abstract

Effective water policies and good governance strategies are essential for sustainable development. Successful management of fresh water resources also requires the integration of the different sectors that use this resource. Therefore, water resource management policies should have an integrated approach that involves social, economic and environmental factors.

Guyana, an American Indian word for "land of many waters", officially the Co-operative Republic of Guyana, is located on the north-east coast of South America. It can be said that water is part of the country's identity, because of its inclusion in the definition of the country's name and because of the abundance of this natural resource within the country's borders. Additionally, the agriculture sector, which contributed 21.8% of Guyana's annual GDP in 2016 uses 94.4% of the annually extracted freshwater. Effective policies and governance strategies are therefore important for the sustainable development of Guyana.

This research investigated the current water policy and governance strategies of Region 4, Guyana. The study assessed how the water threats of the Region are outpacing existing water management policies. It also analysed policy gaps in the existing legislation through the lens of the adaptive integrated water resource management (AIWRM) process. This was done by using data from semi-structured interviews and by analysing existing laws. This study thus advances understanding of using the AIWRM process for policy development and implementation in Region 4, Guyana.

The results show that there are multiple challenges to water policy in Guyana and that the existing laws are not effectively addressing these policies, because of several factors, such as the age of the legislation, the technical nature of the management strategy proposed by these laws, and

the general top-down governance structure established by these Acts. These factors limit the ability of existing laws to effectively manage current and future water challenges in Region 4, Guyana. The results also show that some of the laws have aspects of AIWRM; however, policies that will give effects to these laws have not been developed, therefore the benefits derived by including the principles of AIWRM into water policy have not been realised. It is concluded that the findings offer insights into how the existing laws can be combined with the AIWRM process to address the current and future water challenges of Region 4, Guyana.

Keywords: Water policy, governance, adaptive management, integrated water resources management, Guyana.

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List of Acronyms

AM	Adaptive Management
AIWRM	Adaptive Integrated Water Resources Management
EDWC	East Demerara Water Conservancy
EIA	Environmental Impact Assessments
EPA	Environmental Protection Agency
GS&WC	Georgetown Sewerage and Water Commissioners
GUYWA	Guyana Water Authority
GWI	Guyana Water Incorporated
GWP	Global Water Partnership
GYD	Guyana Dollars
IWRM	Integrated Water Resources Management
NDIA	National Drainage and Irrigation Authority
RDM	Robust Decision Making
US	United States
USD	United States Dollars
WHO	World Health Organization

Chapter 1

Introduction

1.1 Introductory statement

This thesis investigates current water management legislation and water management strategies in Region 4, Guyana and demonstrates that a structured shift to an adaptive integrated water resources management (AIWRM) policy framework is essential for the country's sustainable development.

There is general agreement that freshwater is an important natural resource for the sustainable development of a country's economy (Biswas, 1991). The economic importance of this resource (Merrey, 2009) has been identified by some countries. For example, Chile has developed policies that seek to demonstrate the economic value of water by adopting market price for this resource through privatization (Bauer, 1997; Schleyer, 1996). In addition to its economic value, freshwater also has social and environmental value (Russo & Smith, 2013). Therefore, the need to efficiently manage this resource should be demonstrated by its inclusion in national development policies and strategies.

Efficient management of freshwater resource often requires the adaption of institutional structures and policy change (Koudstaal, Rijsberman, & Savenije, 1992). Identifying the appropriate policy objectives is important for the design and successful implementation of water management policy in Guyana. However, the successful management of freshwater resources also requires the integration of the different sectors that use this resource. Therefore, water resource management policies should have an integrated approach that involves the social economic and environment factors. Policy or management options need to consider both short- and long-term sustainable economic development. Effective water policy will also seek to establish a balance

between the supply management and demand management of the water resource to enable sustainable development (Koudstaal et al., 1992).

While there are several laws that address the management of water resources in Guyana the principle one being the *Water and Sewerage Act*, there is currently no national water policy. Current and emerging water challenges are not sufficiently resolved through existing legislation and governance structure. Sustainable management of Guyana's freshwater resources, specifically the freshwater resources of Region 4, should be proactively addressed by identifying and addressing policy gaps and governance issues. Additionally, the development of a national water policy that has support from multiple stakeholder groups and is capable of adaptive change, considering new information and challenges, will facilitate sustainable development (Ringler, Bhaduri, & Lawford, 2013), because a water policy that incorporates the principle of managing water across sectors will promote sustainable use of the resource in the various sectors. Thus, economic development will be allowed that will not negatively impact the ecological functions of the natural resource or the social wellbeing of water users (Ringler et al., 2013). Region 4 has been selected as the area of study to develop an understanding of governance and policy-related water challenges in Guyana. Several characteristics of Region 4 contributed to this Region being selected as the case study for this research. One such factor is its economic significance to Guyana's development. Most of Guyana's agriculture production comes from the coastal strip, which includes Region 4. This coastal strip represents approximately 5% of the total land area of the country, that is, 10,000 km^2 of the 215,000 km^2 of Guyana's total land mass (Hickey & Weis, 2012). Thus, any water challenge that reduces agriculture productivity will affect sustainable development in Region 4. For example, due to the El Niño drought of late 2015 to early 2016, the sugar cane industry experienced an 18.7% reduction in sugar cane production (BudgetSpeech,

2017). This reduced sugar cane production affected exports, thereby affecting the national GDP. In addition to its economic importance this Region is very important to the stability of the social system of Guyana because 90% of the population lives in Region 4. This Region forms part of the coastline of Guyana that is approximately two metres below sea level (Collymore, 2005). Water related threats such as flooding can therefore affect the development of the Region's economy and social system if not managed in such a way as to reduce the negative impacts on these systems. Additionally, this Region was declared a disaster region following the 2005 flood (Collymore, 2005).

1.2 Problem statement

Guyana signifies "land of many waters", but, as stated in the introduction section of this research, the mismanagement of this resource has negatively impacted the country's economy. Agriculture is the main productive sector of Guyana's economy contributing 21.8% of the GDP in 2016 (CIA, 2016). This sector uses approximately 94.4% of the fresh water extracted annually (FAO, 2016). The efficient management of water is therefore important for the sustainability of this sector.

The problem is that legislation that is being implemented today, such as the Water and Sewerage Act (2002), the Environmental Protection Act (1996) and the East Demerara Water Conservancy Act (1935), are not sufficient for managing current water challenges, such as climate change, floods and pollution. For example, although Region 4 experiences flooding annually during the rainy seasons, flood management strategies are reactive and not preventative. This situation is further complicated by irregular maintenance of drainage infrastructure, limited financial and human capacity, and poor land-use planning (P. Williams & Johnson-Bhola, 2009).

This problem is further complicated by the unavailability of the relevant data to inform policy design and implementation. There is limited data regarding surface water quality and quantity, and no data regarding ground water quantity (Spillman, Jernigan, & Scott, 1998). The impact of the current water usage patterns on the freshwater resources is unknown, due to the absence of these data. Research has not been carried out to determine the status of the Regions' freshwater resources. Water management laws in Guyana should aim to resolve existing and future water challenges so that sustainable development can occur while efficiently using the resource. Water management policies should be developed to allow for integrated water resources management while at the same time permitting the policy to accommodate changes to management structures as more information becomes available.

1.3 Research questions and objectives

As stated in Section 1.2, the problem statement of this thesis, the current and future water challenges of Region 4, Guyana, are not easily resolved with the current legislation and governance structure. For example, Section 10 of the *Water and Sewerage Act* states that the Hydrometeorological Department may establish agreements with other agencies to monitor water resources and to obtain information to inform its monitoring plans. This section of the law provides for lateral collaboration for managing the resource. However, it does not allow for the collaborative management of the water resource at the lowest appropriate level, such as with farmers or other water users. Therefore, there is no mechanism to incorporate local information that might inform and improve monitoring. These challenges have implications for the sustainable development of the Region, because sustainable development requires that policies and management strategies for natural resources management allow for the strategies to be flexible so as to allow changes as new information becomes available, and for them to be integrated across the different sectors,

permitting management at different levels and scales (Folke et al., 2002). To address these problems, three research questions and objectives were developed, as shown in Figure 1. The research questions are:

1) How are the water threats of Guyana outpacing existing water management policies?
2) Where are the critical policy gaps in the existing legislation that deals with water management?
3) Could an adaptive integrated water resource management approach effectively resolve the existing policy gaps?

To answer these research questions, the following objectives were developed:

1) Identify water threats in Region 4, Guyana, from the information provided by the respondents during the semi-structured interview session.
2) Identify policy and governance issues with water management in Region 4, Guyana, from the information provided by the respondents during the semi-structured interview sessions.
3) Analyse the relationship between the water threats and the water policy issues through the lens of an AIWRM framework to address policy gaps identified through the research findings.

The objectives of this research were achieved through a review of literature, document analysis and semi-structured interviews. The latter allowed for the acquisition of specific data related to the management of water resources in Region 4, Guyana. The multiple stakeholders selected have experience in water management in the Region and are involved in policy design and implementation. Therefore, their technical level of understanding can help to inform policy design and implementation.

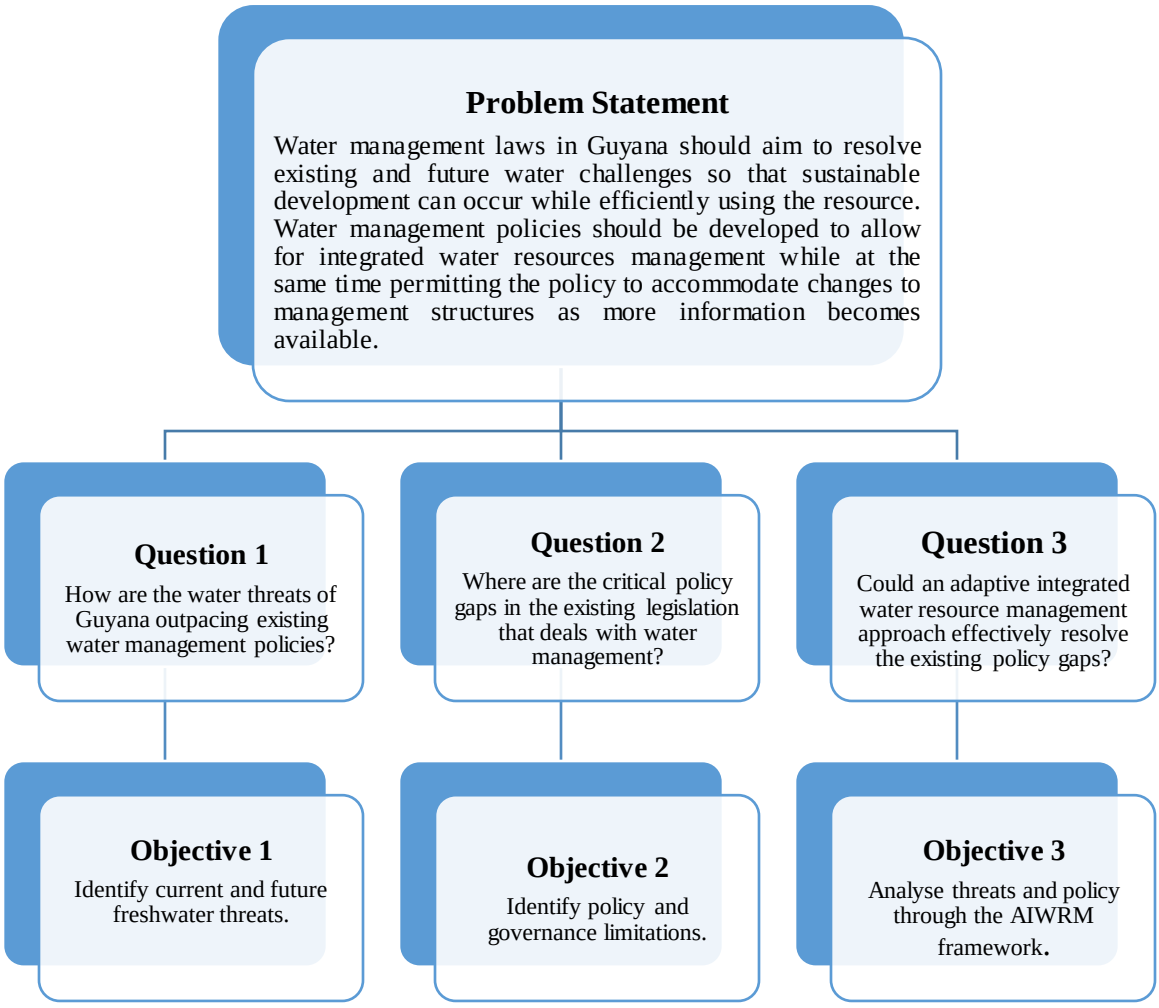

Figure 1. Relationship between the Problem Statement, Research Questions, and Research Objectives.

1.4 Thesis structure

This thesis consists of six chapters that present the findings from the literature review, document analysis and semi-structured interviews. These chapters include:

1) Chapter 1–Introduction: This chapter introduces the research problem and the importance of efficient management of freshwater resources to sustainable development. It proceeds to outline the research questions and objectives that formed the major part of this research.

The chapter concludes by providing a problem statement of the freshwater resources management governance and policy issues in Region 4, Guyana.

2) Chapter 2–Literature Review: This chapter provides an analysis of the adaptive integrated water resources management (AIWRM) process. It first reviews literature on the integrated water resources management process and the adaptive management process, and develops a narrative on the combination of these two processes for water management. The chapter concludes by providing a problem statement of the freshwater resources management governance and policy issues in Region 4, Guyana.
3) Chapter 3–Methodology: the chapter presents an outline of the methodology used to conduct the research. The methodology, as presented in Figure 2, comprises three main stages. These are the literature review, document analysis and semi-structured interviews of multiple stakeholders. The three research stages provide information that informs the results, discussion, conclusion, and recommendation sections of this thesis. This chapter also introduces the study area by providing a geographic description of the Region and an assessment of available freshwater resources.
4) Chapter 4–Results: All information related to water threats, governance and policy challenges obtained during the semi-structured interviews are presented in this chapter. The data presented leads to the analysis of the challenges and the specific situation of Region 4, Guyana. It helps to determine the appropriateness of the AIWRM framework for the development and implementation of water policy applicable to Region 4, Guyana. The results of the document analysis, that is, a review of the existing laws that addresses any aspect of water management, are also presented in this chapter. Additionally, this chapter of the research also presents an interpretative critical analysis of the governance structure

for water management in Region 4, Guyana. The chapter concludes with a summary of the policy gaps identified in current legislation and the threats to sustainable development from these policy gaps and governance challenges.

5) Chapter 5–Discussion: Presents an overview of the main findings of the semi-structured interviews. Appropriate literature is re-examined to analyse the findings and determine the implications for using the AIWRM framework for water policy design and implementation.
6) Chapter 6–Summary, Conclusions and Recommendations: this chapter presents a summary of the findings of this thesis. First the challenges are restated, followed by a summary of the main themes obtained from the results and discussion chapters. This chapter aims to answer the research questions. Recommendations for the improvement of water management in Region 4, Guyana, and suggestions for further studies are also presented in this chapter.

1.5 Conclusion

The main conclusion of this thesis is that a national water policy that is developed using the combined adaptive management and integrated water resources management strategy can be successfully implemented if the policy gaps identified are addressed. The next chapter introduces the research problem in more depth and elaborates on the key research questions.

Chapter 2

A Review of Relevant Literature

2.1 Introduction

This section of the thesis looks at the literature elated to the adaptive management (AM) and the integrated water resources management (IWRM) processes and their application to water policy and governance. The different methodology for implementing these processes are reviewed. Finally, a review of the emerging literature on combining these two processes for addressing uncertainties that water managers face in developing and implementing effective water policy and governance strategies.

2.2 Prominent policy framework and theories

In Guyana, water resource management challenges, such as floods and droughts, are generally resolved through the use of irrigation canals and water conservancies (reservoirs) (Misir, Arya, & Murumkar, 2013). However, climate change has presented water resource managers with uncertainties relating to water quality and quantity (Murdoch, Baron, & Miller, 2000; Vörösmarty, Green, Salisbury, & Lammers, 2000; Whitehead, Wilby, Battarbee, Kernan, & Wade, 2009). Water managers therefore need a suite of appropriate tools to address these uncertainties. It is suggested that one such tool would be the development and implementation of policies that can resolve the current water issues as well as anticipate future challenges and adapt to address these uncertainties. It is also suggested that an integrated cross-sector approach to managing freshwater might be most effective in addressing unanticipated water related stress. The selection of a suitable policy framework for Guyana should be an essential part of the development of an effective water policy. The following is a review of the literature relating to the integration of adaptive governance with the principles of integrated water resource management (IWRM), that is, adaptive integrated water

resource management (AIWRM) as a possible framework to inform the development of a national water policy for Guyana.

2.3 What is adaptive management?

Adaptive management is a process that is used for the management of natural resources when limited information of the system under consideration is available (Folke et al., 2002). This form of natural resources management was first introduce by Holling (1978), who in their work on resilience theory found that a by treating a system as an experiment where the management option applied is the hypothesis, allows for a better understanding of that system. And helps managers to better understand that system as the success or failure of a chosen management strategy is observed (Ostrom, 2009). It is now considered that this management approach might be suitable for the management of freshwater catchment in situations where the effects of challenges to the system, such as climate change are uncertain(Pahl-Wostl et al., 2007). And where the impacts of a chosen management tool unknown(Medema, McIntosh, & Jeffrey, 2008). Additionally, it is emphasised that the adaptive management framework is flexible and permits changes to governance regimes at specific time periods as the impacts of previous strategies on the system becomes known (Allen, Fontaine, & Garmestani, 2013), thus making this form of management appropriate for freshwater resource management. This form of management involves the development and implementation of programs to achieve specific management objectives and by capturing the lessons learned from these programs to inform changes to management(Lee, 2001). For example, it might be the objective of water managers of a certain catchment to reduce point source pollution by a set percentage and date. However, the best method to achieve this goal is not initially known. Therefore, the management strategies that permits changes as the effect of

one management option is analysed enables the managers to adjust their strategies to achieve their objective.

Because of the continuous cycle that is presented by the adaptive management process (Medema et al., 2008), it is also considered an appropriate framework for the development and implementation of water policies (Pahl-Wostl, 2007), because it allows for the inclusion of water monitoring data and research on water management to be incorporated into the policy development and implementation cycle(Lindenmayer & Likens, 2009).

Ostrom and Gardner (1993) looked at the adaptive management process as a framework for informing policy development and implementation for the sustainable management of common pool resources, such as water for irrigation. They found that shared norms and values can lead to system sustainability. Additionally, this form of management allows for the common values of the system to be included in and protected by policy (Brunner & Colburn, 2002).

2.4 Adaptive management framework

Although knowledge of climate change has improved or increased over the years, the exact impact of climate change on fresh water resources at a specific location is not known (Herrfahrdt-Pähle, 2013). Thus, climate change presents another set of unknowns for the development of water management policies. Because of these uncertainties around the future of water availability and quality and the ever-changing challenges, the need for appropriate polices become more apparent. Policies should therefore seek to address present and future problems while learning from past failures and successes. The traditional methods for policy development involved predictions based on past experiences that could result in policies that are locked in time (Walker, Marchau, & Swanson, 2010). The need for adaptive policies in the face of uncertainties becomes important and necessary to protect social, ecological, environmental and economic systems. Walker, Rahman,

and Cave (2001) in their research explored the notion of adaptive policies, that is, policies that are constantly changing as more information becomes available. This policy design approach allows for the development of policies that address immediate challenges while creating a governance structure that allows for other phases of the policy to be implemented as the situation changes and as more information becomes available. A framework for the development of adaptive integrated water resource management policy is needed for this generation of water resource managers to cope with the complexity of water challenges, and for the sustainable management of water resource

2.5 Tools for informing water management policy design

The success of water management policies depends on selecting the right tools for informing their design and successful implementation. One of the suggested methods is a review of the decision-making structure to determine if it is centralised or not and to identify if this structure has been successful in policy design and implementation. Swanson et al. (2010) indicated the need for decentralised decision making to the most immediate or appropriate spatial scale to increase the possibility of resolving issues.

Other researchers suggest using robust decision making (RDM) as the quantitative method for decision analysis to inform adaptive policies designed under uncertainties. Lempert and Groves (2010) state that their methodology is different from other analytical software because it does not analyse a problem to provide an optimal solution, but rather presents multiple alternative strategies to inform policy design, thereby making it an effective tool for the development of adaptive policies.

The scenario discovery concept as a method to inform adaptive policy design has also been proposed for adaptive policy design. Bryant and Lempert (2010) applied this method to evaluate a

proposed US renewable energy standard. Using this method, they could identify weaknesses in the proposed policies and suggest the appropriate trade-offs.

While quantitative methods for informing policy development is effective, they do not always allow decision makers to reach an in-depth understanding of the policy problem, because these methods generally select the best policy option out of a given set of possible scenarios. A greater understanding of the policy problem can be obtained through consultation with the persons that are most affected by the issues. This allows for the development of policies that consider local knowledge and expertise, thus making implementation easier at the lowest level. A combination of quantitative method and stakeholder involvement and consultation will therefore provide a precise analysis of the policy problem. This is supported by Juhola and Kruse (2015) who state that a different methodology yields different results. They cautioned that the selection of a methodology for informing policy should be done carefully. They further stated that results that are generic in nature are more difficult to use in informing policies; thus they support quantitative methods as well as qualitative methods using a combination of models, interviews and questionnaires, because this combination of methods allows an analysis of the situation from the different stakeholder perspectives.

Stakeholder consultation to inform water adaptive policy design does not always ensure that the final policy and its consequent implementation would reflect the inputs of the stakeholder. By using multi-value qualitative comparative analysis to analyse eight water management regimes in Europe, Africa and Asia, Huntjens et al. (2011) found that while the development of policies was done with stakeholder consultations, the policies that resulted did not reflect this and, as such, policies exhibited a top-down governance structure. The implementation of an adaptive water management policy is hampered by the top-down government structure, and therefore decision

makers who seek implementation of adaptive policies should consider the current governance structure, and design policies that can be adaptive and implemented by the existing governance, since it can be difficult to change a centralised governance structure; this is especially so in developing countries where institutional capacity is low. Walker et al. (2010) suggest that identifying the appropriate institutional arrangement for the development and implementation of adaptive water resource management policies is a significant variable in determining whether these policies fail or are successful.

While different methods are used to develop adaptive policies, another hurdle that needs to be overcome is the political atmosphere, since this affects whether a policy is implemented. By modelling the different scenarios for the Rhine Delta, Haasnoot, Kwakkel, Walker, and ter Maat (2013) were able to demonstrate that a qualitative analysis of a policy problem can result in the development of policy and pathways that are adaptive, thus allowing decisions to be based on the preferred pathway, without the interference of political preference.

As stated before, adaptive policies are effective for addressing uncertainties. This is also true for political uncertainty or instability. According to Marchau, Walker, and Van Wee (2010) political instability slows the implementation of policies. However, uncertainties are possible in situations for the development and implementation of adaptive policies, since these allow for the immediate implementation of a policy that addresses a current issue and allows for the policy to be adjusted as situation changes. Policies based on specific assumptions of the future are likely to behave poorly if a different future from the one predicted occurs. This further facilitates implementation since policies can be implemented before all uncertainties are resolved.

While it has been established that the uncertainties facing policy makers demonstrate the need for adaptive policies, the implementation challenges that these types of policies will continue

to encounter are the legal and political barriers, because existing laws have long catered for the static policy-making framework. As Walker (2000) stated, a political environment that allows for the adjustment of policies by predecessors is an enabling environment for adaptive policy implementation.

Moench (2010) argues that although we cannot predict the future and determine all the possible uncertainties, it is necessary to plan for the sudden stress that our systems might be exposed to, since the ability of a community to survive – that is, a community resilience – is linked to its ability to adapt. Policies that adapt as new information becomes available are therefore needed, especially in developing countries that lack the resources and institutional capacity to respond quickly to unexpected shocks. These policies, however, need to enable actors at multiple levels to respond to different situations; most importantly, actors at the local level need the institutional framework to act at their level because this is the level that often has the timely knowledge about a situation and the actors can respond faster.

In addition to all the qualitative and quantitative methods recommended for the development and implementation of adaptive water resource management policies, another factor for consideration and inclusion in the methodology is the use of indigenous knowledge. Misiedjan and Gupta (2014) stated that indigenous people should be consulted, and the potential impacts of any policy on their livelihood should be assessed. This would increase the probability of success for the policy should it be implemented.

Adaptive policies for water management should be integrated with other sectors such as spatial planning. De Smedt (2014) suggested that the consideration of space for the management of water will aid in the successful development and implementation of these policies. Allowing land space to be available for the maintenance of water level during droughts and to control the

flow of water during floods is an example where the integration of these sectors will improve the management of water.

An understanding of the hydrologic system is another tool that is useful for informing water policy design. This will inform the decision makers of the most appropriate scale for the implementation of different policy options. For example, an understanding of the connectivity of the surface and groundwater system would inform the development of an appropriate plan for management of these resource. Sophocleous (2000) in his research indicated that the sustainable management of water resource is a public policy problem because of the increasing competition between the different sectors. Specifically, he emphasised the need to balance economic development with environmental sustainability. He further proposed that for policies to be successfully implemented, an understanding of the hydrologic system is necessary, and that the tendency to develop policies based on the natural recharge is limited, since it considers that the rate of natural recharge is steady, which is often not the case when the pumping rate or location of wells are considered. This researcher concluded that the development of appropriate water management policy and its successful implementation requires an integrated approach involving stakeholders from the community levels.

2.6 What is integrated water resource management?

Integrated water resource management promotes the management of water at the catchment level by combining different management scales and the inclusion of multiple stakeholder (Blomquist, Dinar, & Kemper, 2005). The main objective of IWRM is the management of water resources in a sustainable manner so as not to affect the functions of the ecological, social or economic systems that utilise the resource (Odendaal, 2002). A clear understanding of what is IWRM and its importance to water management is presented in the definition of the framework

given by Global Water Partnership; " a process that promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems"(GWP-TAC, 2000).

2.7 Integrated water resource management (IWRM) policy design and implementation

Integrating the adaptive management theory with the principles of integrated water resource management (IWRM) should provide a robust framework for the development of a water policy that will address the current water challenges of Guyana, because adaptive management aims to efficiently manage natural resources by reducing the uncertainties related to availability and quality of a natural resource (Rist, Felton, Samuelsson, Sandström, & Rosvall, 2013), while IWRM allows for the reduction of uncertainties across sectors, both vertically, at different governance levels, and horizontally, at the same governance levels across sectors (Herrfahrdt-Pähle, 2013).

Additionally, IWRM has been presented as an effective framework to inform policy design, because it encourages horizontal and vertical collaboration for the management of freshwater. This theory also promotes the management of a water resource at the watershed scale, while considering the social, environmental and economic components of the system involved. Implementation of IWRM policies has encountered various challenges. These challenges are associated with the method employed to inform the policy development, the selected scale for governance and the institutional and governance structures that were in place or that were developed for the implementation of IWRM policies.

Although IWRM is presented as a method for a bottom-up approach to water resource management, if not implemented correctly, the resulting institutional structure will operate with a

top-down management, despite having the characteristics of IWRM. Hu et al. (2014), through his analysis of IWRM policies implemented in China, argued that the difficulty in implementing IWRM is mostly identified at the local level. This suggests that when using the IWRM principles to inform policy design and implementation, establishment of governance structures at the local level by central government is not enough to ensure that collaboration and participation occurs at the lowest level. Community members need to be educated on the purpose of the system and have a good understanding of its structure for it to be useful in successfully implementing IWRM policies. This indicates the need for a more collaborative approach in the development of policies to facilitate its implementation.

In addition to the difficulties in implementing IWRM policies due to inefficient or non-existent collaboration, this form of policy is also limited by the disconnect between the theory of IWRM and the practical implementation of IWRM policies. Ferreyra, de Loe, and Kreutzwiser (2008) argue that while the theory gives the need for horizontal and vertical institutional collaboration and cooperation, the practical implications of IWRM indicate the need for the structure of the local governance scale to be developed by the stakeholders and not by central government.

It is further argued by Yu, Edmunds, Lora-Wainwright, and Thomas (2016) that the adoption of the IWRM principles needs to be done on a context-specific basis, taking the local policy and governance structure into consideration, and developing management options that will be integrated, but specific to the location or watershed in question. However, although the institutions might have all the principles necessary for the successful implementation of IWRM, this does not guarantee that water management will become efficient. Along with the technical and biophysical factors, consideration of user behaviour and incentives for the local level users to be

fair and conservative in their use of the water resource should inform the development of IWRM policies.

One of the main indicators of successful implementation of the IWRM is the existence of water laws or policies. However, Donoso and Bosch (2015) suggest that when implementing the principles of IWRM for the development of water policies, it is important to remember that these principles should not be seen as another water plan. IWRM takes into consideration the characteristics and needs of each country. Successful implementation of these principles needs to consider the national capacity of the country in question. An enabling environment is needed, and conflicting priorities and interests often exist. Water policies need to consider not only the sustainability of the natural resource, but also the wellbeing of the resource users. The successful development and implementation of a water resource policy that is both adaptive and integrated need to consider the cultural differences of the different stakeholder groups.

The creation of parallel institutions is another concern when developing IWRM policies. Van der Zaag (2005) argues that institutional capacity and coordination continues to be an obstacle for the implementation of IWRM. When implementing IWRM policies, decision makers need to be aware of the possibility of creating parallel institutions when the aim is to integrate existing institutions. This is especially important with the noted capacity shortage that exists, especially in developing countries by taking into consideration existing customary practices as the institutions are formed. Successful implementation therefore involves an environment where water managers can identify problems in water management and facilitate the process for the development of a solution involving all stakeholders.

Al Radif (1999) and Jeffrey and Gearey (2006) argue that the IWRM principle presents a demand-management approach and supply-management approach to water management. This

approach if successfully implemented should assist water managers to address the uncertainties of the state of the water resource in the future, related to water availability and varying water quality.

Policy coordination is also an import method for informing the development of IWRM policies. According to Foster and Ait-Kadi (2012) insufficient policy coordination can affect the development and implementation of IWRM policies. More clarity is needed on how to successfully implement IWRM policies for water management. Groundwater scales and the framework necessary for addressing the land use and water management on ground water resources should be considered when developing IWRM policies. For successful implementation, top-down and bottom-up management with political support is necessary.

An integration of the sectors that manage the different resources at multiple levels is needed. This is supported by Jønch-Clausen and Fugl (2001) who argue that IWRM not only focuses on the integration of the natural resources as it relates to water management, but also on the integration of the human resources. Policy objectives therefore need to be developed through consultation with the different stake holders for the successful implementation of a IWRM policy.

Mitchell (2005) argues that the successful implementation of IWRM principles in the form of policy requires a supporting law, since the lack of a statutory base will create challenges for water managers to implement IWRM principles. This is also supported by Nyambod and Nazmul (2010) who states that a reformation of water laws and institutions is necessary for the development and implementation of IWRM principles.

With the aim of showing commitment to IWRM principles, competition between agencies is also created. This is because the common goals and objectives for water resource management shared by the different stakeholders are not identified and acted upon. This situation was recognized by Saravanan, McDonald, and Mollinga (2009) in India and in the Netherlands, as well

in as South Africa and Australia, and thus successful policy implementation is effected. The development of IWRM policies should therefore clearly reflect the aims and objectives of each actor, the source of funding for policy implementation, as well as detailed information regarding institutional structures and roles.

The importance of local knowledge and involvement for the development and implementation of IWRM policies should not be underestimated. Dungumaro and Madulu (2003) stated that the process of IWRM is effective when there is a cordial relationship between water users and regulators, because this will determine if, when, and how conflicts are resolved.

Cohen and Davidson (2011) suggest that the watershed as presented by IWRM as a policy framework might not be the best approach for water management, since the watershed was originally a technical approach for defining and managing the hydrology and it has made a leap from tool to governance without considering the governance implications. Hence there are often difficulties in implementing policies that are developed with the watershed as the scale for governance, since the administrative and hydrologic boundaries differ from each other in most societies where this type of policy is likely to be implemented. An analysis is therefore required of the existing scales of governance versus scales of hydrology when designing policies for water resource management.

IWRM should be considered a process for informing water policy development and implementation, and not an end goal for water resource management, because, according to Savenije and Van der Zaag (2008), IWRM is a holistic approach to water management that considers different geographic, spatial and time scales. It also considers the various reactions of the different scales to stress.

Because of its cross-sectoral approach, the process of IWRM combined with the concept of adaptive management will allow freshwater systems to adapt to uncertainties and allow water managers to adjust management practices as more information about the impacts of climate change and other factors on different systems becomes available.

2.8 Combining adaptive management with integrated water resource management

The merger of AM and IWRM for improved water management has been steadily increasing(Medema et al., 2008). There are several trains of thoughts regarding the success or failures of combining the AM and IWRM management processes for improved water policy and governance. Rahaman, Varis, and Kajander (2004) states that because of the ridged governance structure of IWRM combining this process with AM will result is difficulties because the implementation of the AM process requires that the governance institution be flexible to change, that is that managers at all levels of the governance structure are given authority for implementing necessary changes to improve management.

This is supported by Engle, Johns, Lemos, and Nelson (2011) who in their analysis of Brazil's IWRM and AM water governance and management model found that the success of combining these two principles depends on the level of centralised management institutions that exists, the mechanism for obtaining and sharing information and the method used for collaboration. They argued that the flexibility of water management under AM is lost when the wider stakeholder participation aspect of IWRM is adapted.

This combined AM and IWRM policy development and implementation approach have been successful in the development of the Canterbury Water Management Strategy, a water management strategy that was developed using the decentralised, collaborative principles of IWRM and the management by experimentation approach of AM in what is referred to as the

strategic choice method for policy development (BR Jenkins, 2013; Bryan Jenkins, Russell, Sadler, & Ward, 2011; BR Jenkins, Russell, Sadler, & Ward, 2014; Lomax, Memon, & Painter, 2010). Additionally, the merger of these two processes have been successful in managing common pool resources by having wider stakeholder participation, governance at the local level, collaboration and observing the impact of management strategy on the water body to decrease uncertainty (Ostrom, 1999, 2009; Ostrom & Gardner, 1993); all components of AM and IWRM.

The combination of these two process allows for the development of relationship and links between scientists and policy makers because it promotes increased collaboration between the different sectors and management levels. It also promotes the need for research and monitoring of the system to inform policy development and design. However, when combining these two processes to inform policy and governance, the tensions and difficulties that result from merging the AM and IWRM principles must be considered.

2.9 Conclusion

This project on the water policy and governance of Guyana seeks to identify the appropriate framework for the development and implementation of water policy. It will contribute to the literature on water governance in developing countries with a special focus on adaptive integrated water resource management framework by improving our understanding of some of the limitations for the successful implementation of water policies in developing countries.

Chapter 3

Methodology

3.1 Introduction

This chapter provides an outline of the process used to answer the research questions. The research objective is to identify gaps in the current policy framework for freshwater resource management in Region 4, Guyana and to evaluate how the principles of adaptive governance and integrated water resources management (IWRM) can be effectively applied to improve water governance.

A better understanding of these water management challenges will be developed through the research question listed in Section 3.3.

The research methodology, Figure 2, was comprised of three stages: A literature review, document analysis of the relevant legislation related to water management in Region 4, Guyana and semi-structured interviews. The first stage of the research process, the literature review allowed for a clear definition of the water policy and governance gaps in Region 4, Guyana and for an understanding of the adaptive management and integrated water resource management process by analysing existing literature. This stage of the research also presented information on the emerging concept of combining these two processes to address water policy and governance challenges. Additionally, this section of the research presented a framework, adaptive integrated water resources management (AIWRM) to assess water policy and governance gaps in Region 4, Guyana. The analysis of the relevant literature presented a foundation for understanding the water management challenges in Region 4, Guyana. This stage of the research helped to guide the semi-structures stage of the research. The final stage of the research process, semi-structured interviews,

provided additional information and knowledge specific to Region 4, Guyana about the water governance and policy issues of the Region.

Details of the study area, Region 4 Guyana is also presented in this section of the thesis.

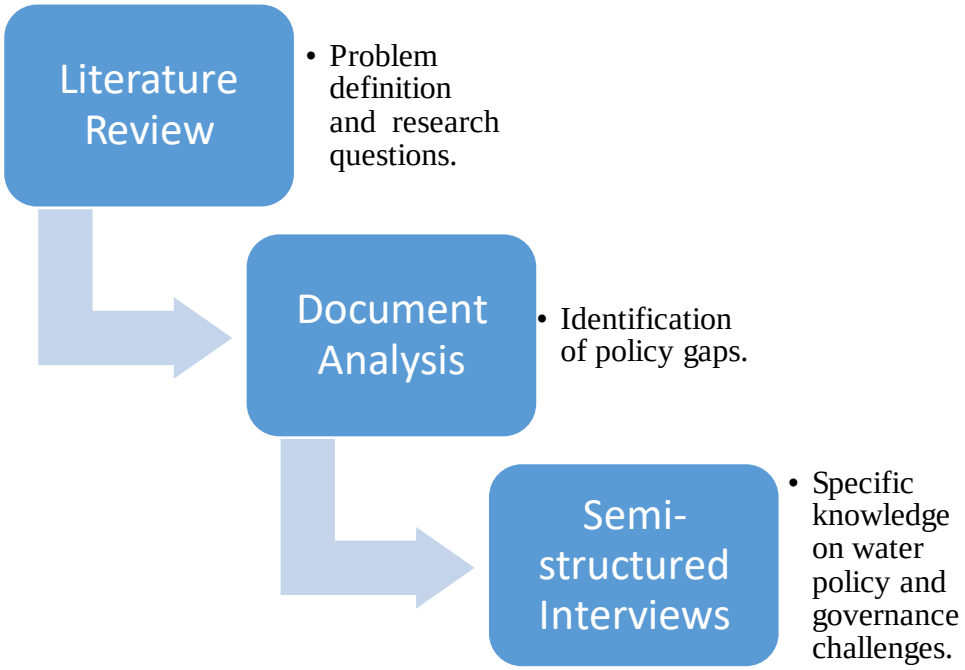

Figure 2. Research Methodology Process. (Baptiste, 2017)

3.2 Description of the study area-Region 4 Guyana

This section of the thesis provides details about the study area to better appreciate the relevance of the research. Geographic information is provided as well as the population of the Region. This is followed by a summary of the water resources of the Region and the importance of efficiently managing the Region's freshwater resources to ensure sustainable development of the Region and the country.

3.2.1 Geographic overview

Guyana, Figure 3, is located on the north-east coast of South America (CIA, 2016). The total land coverage is 215,000km^2. This country shares borders with Suriname, Venezuela and Brazil at its east, west and southwest boundaries respectively, and a 459km Atlantic coastline to the north. Guyana's internal boundaries consists of 10 administrative regions and 5 geographical regions (Spillman et al., 1998).

Figure 3 Map of Guyana highlighted in green. (Beautiful World, 2017)

Guyana has retained approximately 80 percent of its dense forest. This forested area is home to several native Amerindian communities. The costal lowlands occupy 5 percent of the

country's land mass. This part of the country has an area represents 5 percent of the country's total land mass and is the highest populated area of the country (Collymore, 2005).

There are six administrative regions located within the costal lowlands including Region 4 (Demerara-Mahaica). Region 4 is the smallest region along the coastal land, about one percent of the total area. And has a population of 313,429 persons, the highest of all ten administrative Regions. This represents 41.9 percent, Figure 4, of the general population of Guyana (Guyana Bureau of Statistics, 2016)

Region 4, home to the capital city Georgetown. It is considered the most developed region with regard to basic amenities such as access to educational facilities, job opportunities and transportation in comparison to the other regions of Guyana (WHO, 2017).

Urban expansion within the Region has increased demand for resources. Water is the primary resource needed by the residents of Region 4. Therefore, it is important to understand the individual and community water needs and to balance this demand with sustainable use to protect ecosystem services will enabling sustainable development (Palanaippan et al., 2010). The sustainable development of Region 4 is linked to the water usage patterns and to the availability of the freshwater resource of the Region. It is therefore important to ensure effective management and to maintain sustainability of the use of the freshwater resource of the Region.

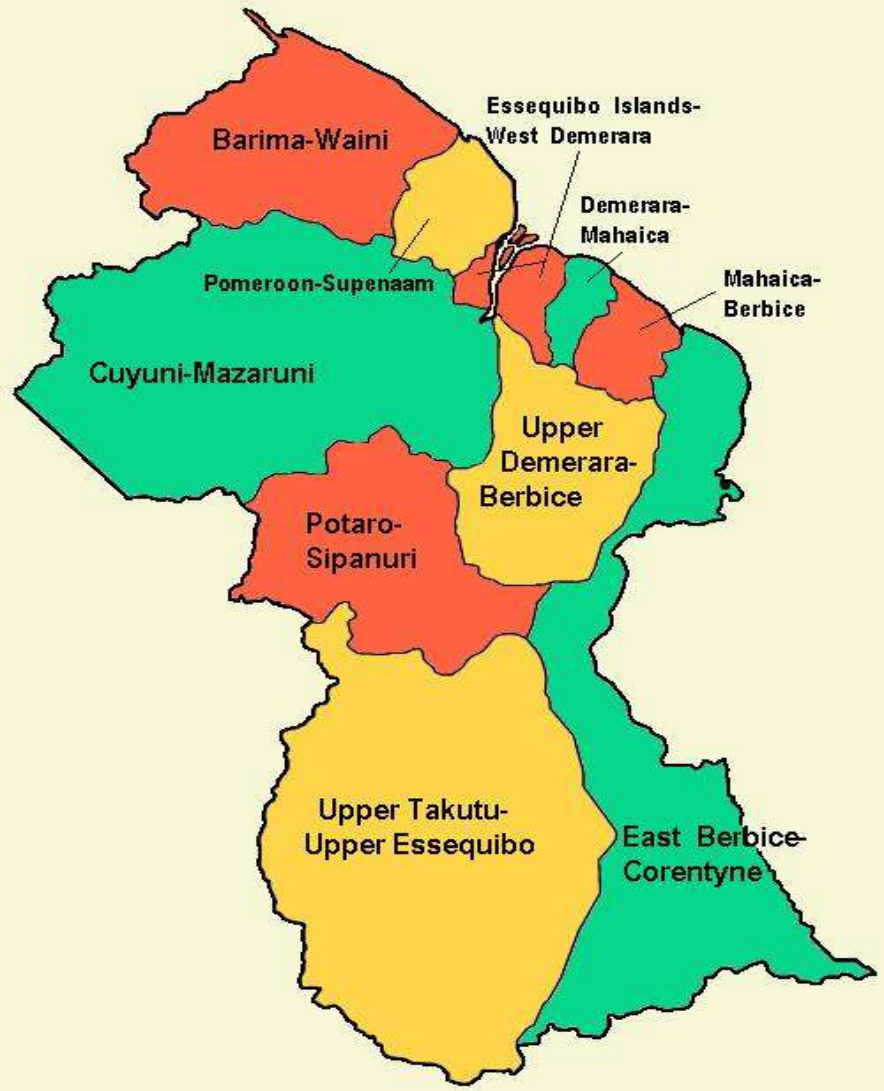

Figure 4. Administrative Regions of Guyana. (Guyana Times, 2017)

3.2.2 Freshwater resources of region 4, Guyana

Guyana, "Land of many waters", formerly British Guiana(CIA, 2016), abundant freshwater sources (surface water and groundwater) are available in all populated areas of the country. The high level of the water table (close to the surface) facilitates extraction from these sources (Bynoe & De Souza, 2010). The average internal renewable water resource of Guyana is 241 km3/year. The yearly average available surface water is 241 km3/year, while groundwater is 103 km3/year.

The overlap, renewable water resource common to both groundwater and surface water, is 103 km3/year (FAO, 2016).

Both surface and groundwater resources are used to satisfy freshwater demand throughout the country(Spillman et al., 1998). Groundwater is mainly used to meet the freshwater demand of the coastal plain area of Guyana. This includes Region 4. However, 30% of the daily freshwater demand for Region 4 is supplied from the East Demerara conservancy water dam (UN-Water, 2013). Because of heavy precipitation, the recharge rate within the Region is high (Spillman et al., 1998). Costal rainfall data for the period 1901-1980 shows an average annual precipitation of 2300mm (Ramraj, 1996). Recent monthly average precipitation is 250-450mm. Monthly average rainfall for the coastal plain between the months of June and August is given as 150-300mm (McSweeny, New, & Lizano, 2009).

3.2.3 Surface water resource

Guyana has many rivers. Essequibo, Demerara and Berbice are the three major rivers. The general flow of the rivers is northward into the Atlantic Ocean (Merrill, 1993). The Essequibo River is the largest of Guyana's three main rivers has a total average drainage basin of 69,300 km^2. It runs from south to north starting at the Brazil-Guyana border and empties into the Atlantic Ocean west of Georgetown a total of 1014km. The Demerara River is the deepest river of Guyana and emerges in the central part of the country flowing northward for 346km discharging into the Atlantic Ocean at Georgetown. This river forms one of the regional boundary for Region 4. The Berbice River rises in the Rupununi highlands region and flows northward to the Atlantic Ocean for 595km. (Berbice River, n.d.). Recharge is attributed to rainfall runoffs. It is estimated that the maximum rate of discharge of three main rivers are 253 km^3/year for the Essequibo River, 14 km^3/year for the Demerara River and 13 km^3/year for the Berbice River (FAO, 2016).

3.2.4 Groundwater resource

The coastal artesian basin of Guyana is comprised three lateral aquifer system, with a common recharge area (Arad, 1983). This aquifer system is in Region 4(Spillman et al., 1998). An interesting aspect of this coastal groundwater system is that its salinity reduces with depth thus improving its quality with depth (McConnell & Dixon, 1960). The three aquifers in this system are referred to as: the "upper" sand because of high iron content this system is not used as a water source; the "A" sand aquifer has a lower iron content than the shallow "upper" aquifer. So, although it is used as a source of water the water is treated for iron removal before distribution; the "B" sand aquifer, is the system that is most exploited for water resource. It has the lowest iron concentration of the three aquifers. Water abstracted from this system is treated with aeration and chlorination to remove traces of hydrogen sulphide (Kundell, 2008). .

3.2.5 Water use in Region 4, Guyana

Freshwater is used for several purposes in Region 4, Guyana. These include water for domestic use, water for irrigation, water for industrial use and water for navigation. Water is also used for recreation and cultural or religious activities.

3.2.6 Management of fresh water resource in Region 4, Guyana

The responsible institutions involved in the management of Guyana's water resources are:

- Guyana Water Incorporated (GWI), a regulatory body created following the Water and Sewerage Act of 2002 which dissolved the Guyana Water Authority (GUYWA);
- the Georgetown Sewerage and Water Commissioners (GSWC). The GWI provides potable water to the entire country and has the additional responsibility of sewerage services;

- the National Drainage and Irrigation Authority (NDIA), dissolved the National Drainage and Irrigation Board (NDIB) in 2004, is responsible for drainage and irrigation countrywide (FAO, 2016);
- The Ministry of Health monitors water quality, sewerage and sanitation activities;
- the Ministry of Public Works, Communications and Regional Development establishes water sector policy; and
- the Hydrometeorology Department of the Ministry of Agriculture oversees monitoring and assessment of surface water and groundwater resources and the provision of basic meteorological information (UN-Water, 2013).

3.3 Research questions

This research aims to answer the following questions:

1) How are the water threats of Guyana outpacing existing water management policies?
2) Where are the critical policy gaps in the existing legislation that deals with water management?
3) Could an adaptive integrated water resource management approach effectively resolve the existing policy gaps?

3.4 Research strategy-Case study

The general method for this research was the case study. This qualitative methodology was chosen because it will enable the investigation to focus on the freshwater policy and governance problem in Guyana. This was done using various data types and it will allow for the in-depth analysis of the different stakeholder perspectives. As per Yin (2009) the strong focus on the problem that is permitted using the case study as a research method, enables the development of

appropriate research questions to better understand the situation. Additionally, according to Brown (2008)brown 2008) , this method is the most appropriate for answering "how" and "why" questions and for when you unable manipulate the behaviours of those involved in the study. The findings from this case study of Guyana can subsequently be compared to and be integrated with other case studies on water governance in developing countries see, for example, Solanes and Jouravlev (2006) who looked at the socioeconomic factors that impact water governance in Latin America and the Caribbean.

3.5 Data collection

Data for this research was collected using a combination of sources. The first set of data was obtained from document analysis of the existing policies and legislation and government documents that relates to water resource management in Region 4, Guyana. The period covered by the documents will be the early 1990s to the present period. To systematically identify policy frames and narratives, NVIVO software was used for qualitative coding.

To obtain specific knowledge on the challenges and gaps in the management of freshwater in Region 4, Guyana, semi-structured interviews were conducted. Semi-structured interviews were the primary source of information collected for this research. It permitted the acquiring of first-hand information on the development and implementation of water related policies in Guyana from multiple stakeholders that are involved in water management or that will be impacted by management decisions. Interviews were recorded using an OLYMPUS DS-2500 digital voice recorder. Interviewees were not required to answer questions that are not related to their professional status since personal data was not required for the aims of this study.

3.6 Literature review

The literature review stage of the research process involved an analysis of the challenges of the water governance and water policy environment in Region 4, Guyana. The literature review identified challenges such as climate change, domestic water distribution challenges, urban development, sewerage disposal and groundwater extraction. A detailed presentation of these water challenges is given in Chapter 4, the results chapter.

3.7 Document analysis

An interpretative analysis of all the relevant laws that address some aspect of water management in Region 4, Guyana was done to identify and analyse policy gaps related to water governance in Region 4, Guyana. The main legislation for water resources management is the Water and Sewerage Act 2002. The analysis revealed the governance structure for water management in the Region involves multiple institutions. This has resulted in uncertainty regarding roles and responsibilities.

3.8 Semi-structured interviews

Twenty-four stakeholders participated in the semi-structured interview sessions. These sessions lasted form twenty minute to two hours in length. The semi-structured interviews allowed the stakeholders to provide clarity on the issues and challenges that were identified during the literature review and document analysis stages of the research. The interviews were conducted in person and at the participants' place of employment. The time and location for the interviews were determined by the participants. These interviews provided specific knowledge on the policy gaps and governance challenges water resource managers encounter in Region 4, Guyana.

Two of the interviews were not recorded. Some of the recorded interviews included more than one participant. Handwritten notes were taken during all the interview sessions to document important points provided by the participants.

3.8.1 Interview questions

The interview outline included open ended questions to allow the interviewee to answer the questions without the bias or influence of the interviewer. The initial stage of the interview included discussion on the general aspect of water issues in Guyana. This form of asking broad questions was used during the interview to keep the session on topic. Specific questions relating to policy development for water management were asked during the latter part of the interview session. This was done to prevent influencing the answers from interviewees.

The following questions were used as initiators for the interview:

1. Do you think that Guyana has a problem with water (shortage/flood/quality/quantity)?
2. What do you think are the main problems with water management in Guyana?
3. What do you think about these problems and their potential impact on the sustainable development of the country?
4. How do you think these problems could best be solved?
5. What is your opinion on the effectiveness of the existing policies to address these issues?
6. Do you think a national water policy will help to address the current and future water issues?
7. How do you think such a policy should be developed?

8. What should be the framework for such a policy?
9. What is your opinion on the current institutional structure for water management in Guyana?
10. Do you think that the existing institutional arrangement should change? Please explain.

3.8.2 Selection of participants

The semi-structured interviews are an important aspect of this research because it supports the data collected from the desk review of relevant documents. This method of data collection also provides an understanding of the different stakeholder perspectives of the development and implementation process for freshwater related policies in Guyana. Therefore, interviewees were chosen based on their level of participation in the development of policies and legislation, their interaction with water users, the potential impact of their organizations activities on the quality and quantity of the fresh water resource and their knowledge and expertise regarding fresh water management in Guyana.

Participants were contacted in the first instance via email and consequently via phone and as a last option in person. This initial contact included an introduction to the researcher and information about the proposed research. Interviewees were asked to schedule an appropriate place and time for the interview to be conducted. All interviewees were provided with a consent form and were given the opportunity to withdraw their interview prior to the commencement of data analysis.

The themes discussed during the interview were provided to the participants prior to the date of the actual interview. Additional hard copies were also provided at the time of the interview.

3.8.3 List of participants

The following is a list of the organizations that represents the stakeholders who were willing to be interviewed.

- Guyana Water Incorporated
- Ministry of Agriculture
- Ministry of Agriculture-National Drainage and Irrigation Authority
- Ministry of Agriculture -Hydrometeorological Service
- Ministry of Communities
- University of Guyana
- National Agriculture Research and Extension Institute
- Ministry of Public Infrastructure
- Guyana Environmental Protection Agency
- Mahaica Mahaicony Abary-Agricultural Development Authority

3.8.4 Data analysis

To ensure a complete analysis, recorded interviews were transcribed verbatim and stored in a secure pace. Each interview was given a code to protect the identity of the interviewer. Data were further analysed both manually and with the aid of NVivo. Themes and opinions about the framework used for policy design and implementation in Guyana were summarised as they were identified during the analysis of the interviews.

3.8.5 Limitations

This research was limited by the availability of interviewees. Meetings dates and times were frequently rescheduled based on the availability of the interviewees. This frequent change in interview schedule can be attributed to two factors. The first is that it was difficult to gain access to upper level management because of their demanding schedules. Their availability changed depending on changes to their different work-related commitment. The second main factor is the period during which the interviews were conducted, that is the Christmas holiday season. During this period persons took their vacation and therefore were unavailable to participate in the interview process.

Another limitation was the method used for communication. The initial method was via email; some organizations were slow in responding to emails and did not have an email address listed as a form of contact.

3.8.6 Human research ethics

Approval for conducting the proposed interviews was sought from the University of Canterbury Human Ethics Committee.

All interviewees were asked to sign a voluntary consent form that allowed for the interview to be recorded and the data to be used in the proposed research. Two participants asked not to be recorded. Their request was granted and their interview sessions were recorded in the form of hand written notes. The information provided by the interviewees cannot be linked to individual participants because of the letter number combination coding system used to identify each interview.

3.9 Conclusion

The research methodology of this thesis was composed of three main stages, literature review, document analysis and semi-structured interviews. These stages of the research process identified gaps and provided information on the water policy and governance of Guyana. These stages in the research contributed to the identification the appropriate framework for the development and implementation of water policy. They also contributed to the literature on water governance in developing countries with a special focus on adaptive integrated water resource management framework by improving understanding of some of the limitations for the successful implementation of water policies in developing countries.

Chapter 4

Results-Semi-structured interviews

4.1 Introduction

This chapter presents the results and analysis of the semi-structured interviews completed as part of the qualitative data analysis for this research. The following objectives have been developed to aid in answering the research questions presented in Chapter 1 and are used to guide the analysis of the data obtained from the semi-structured interview sessions:

1. Identify water threats in Region 4, Guyana from the information provided by the respondents during the semi-structured interview session.

2. Identify policy and governance issues with water management in Region 4, Guyana, from the information provided by the respondents during the semi-structured interview session.

3. Analyse the relationship between the water threats and the water policy issues through the lens of the AIWRM framework to address policy gaps identified through the research findings.

The identification of threats to the water resources in Region 4 is presented in Sections 4.2 to 4.4 This analysis of the data will aid in answering the first research question: How are the water threats in Region 4, Guyana outpacing existing legislation? The identification of issues with water policy and governance in Region 4, and an analysis of the existing policy environment will contribute to answering research questions 2 and 3. The threats to the water resources of Region 4 identified by the respondents are presented in the Section 4.2.1 below.

4.2 Water threats in Region 4

Fourteen threats to the freshwater resources have been identified by the respondents, ranging from the most frequently mentioned – flooding – to the least mentioned by the respondents – waste management. These threats are grouped into three major themes, threats related to water quality, water quantity, and water management.

4.2.1 Identifying the water threats in Region 4

The following is a list of threats and issues that are challenges to the freshwater resource of Region 4, Guyana, identified by the respondents:

4.2.2 Threats related to water quality

1) Pollution
2) Salt water intrusion
3) Waste management

4.2.3 Threats related to water quantity

4) Floods

5) Drainage capacity
6) Urban development
7) Groundwater mining
8) Water storage
9) Climate change
10) Climate variability

4.2.4 Threats related to water management

11) Methods of communicating information between stakeholders
12) Limited financial resources
13) Human resources shortage (technical capacity)
14) Conflicting use

The identification of these threats to the water quality and quantity of Region 4 will aide in determining areas of the legislation that need to be strengthened to address these issues.

The three main threats to the freshwater resources of the Region identified by the respondents are: lack of financial resources, pollution and flooding.

Flooding is the most prominent issue that affects freshwater resources in the Region (Figure 5). Twelve of the respondents mentioned flooding as a threat to the freshwater resources of the Region, affecting both urban and rural areas.

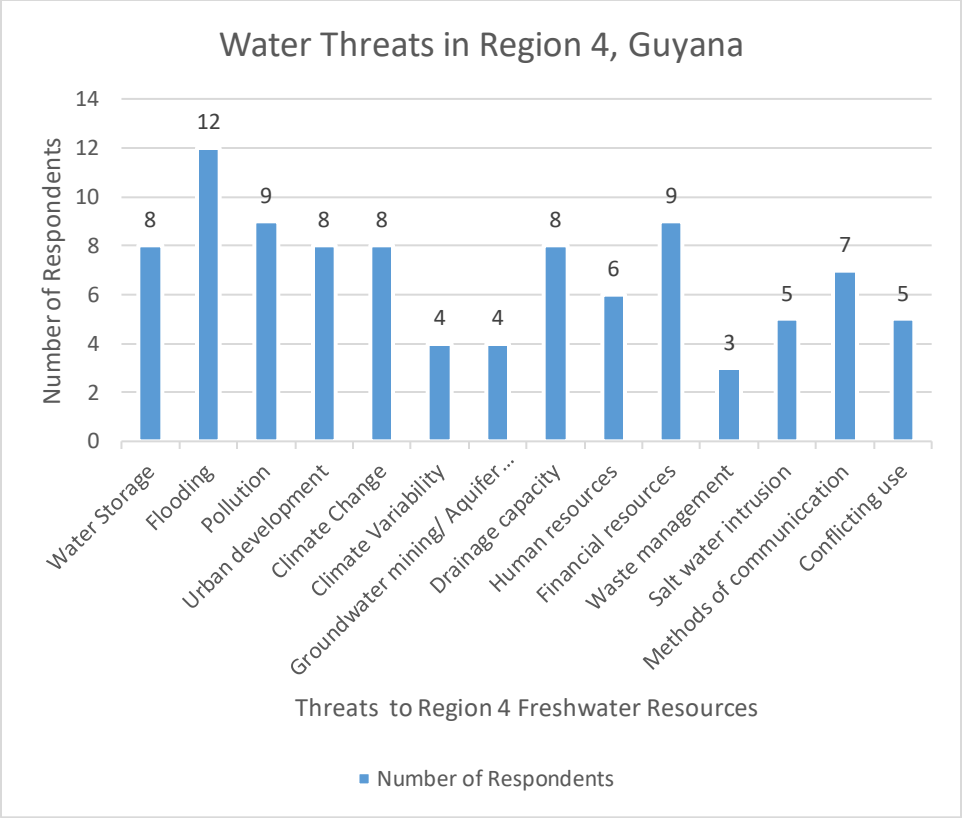

Figure 5 Water threats in Region 4, Guyana. (Baptiste, 2017)

The other main threats are pollution and lack of financial resources, both of which were identified by nine respondents. Lack of financial resources affects both rural and urban areas of the Region and is a threat to the water quality and availability of the Region, because providing clean water on demand to the various users is costly. Limited financial resources therefore limit the ability of the agencies that are responsible for providing and maintaining water quality throughout the Region. Pollution is another threat to the Region's freshwater resources. This affects water quality and is linked to domestic waste, as well as agricultural farm runoffs.

Other threats such as climate change, urban development, insufficient water storage capacity, insufficient storm runoff and drainage capacity were each identified by eight respondents.

This indicates that these are considered major threats to the management of the freshwater resource of the Region.

4.3 Understanding the water threats in Region 4

This section presents the impact of the threats to the Region's freshwater resources as understood by the respondents. As stated in Section 4.1.1 these impacts are grouped into three categories, water quality, water quantity and water management.

4.3.1 Understanding threats related to water quality

The respondents identified three main threats to the water quality of Region 4: pollution, saltwater intrusion and waste management. These are further developed in Sections 4.2.2 and 4.2.3.

4.3.2 Salt water intrusion

Salt water intrusion has been known to affect the water quality of the Region. Mainly the surface water is affected, especially during periods of drought (Interviewee 10). Because of the tidal nature of the rivers, and the difference in density between freshwater and saline water (the latter being heavier), extended drought causes the salt water wedge to go further inland than it would during normal weather conditions (Interviewee 4). This affects the quality of the water for all users since saline water is not suitable for domestic, industrial, nor agricultural use (Interviewees 5 and 15).

4.3.3 Pollution and waste management

Pollution is a threat to the freshwater quality of Region 4. Issues such as distribution pressure and leakages in the distribution system, vandalism, poor installation and poor maintenance contribute to pollution of the Region's freshwater resource (Interviewee 12).

The domestic water distribution system is connected to the power distribution system, with no backup power system of its own. During periods of no current, there is low pressure in the

system. Some of the domestic water distribution pipelines are installed close to, and in some cases in, drains; this means that if there are leaks in the pipelines during periods of power disruption, the water distribution system is exposed to contamination because of the change in pressure (Interviewee 12).

Another factor that contributes to pollution in the Region is improper use and disposal of chemicals. Region 4 is one of the large agriculture regions of the country (Interviewee 8). Pesticides and herbicides are used in agricultural practices throughout the Region. Runoff or flooding in these areas results in contamination of the waterways (Interviewee 12b).

Region 4 is the most densely populated region. Thus, agriculture chemicals and household waste get into the waterways and pollute them, negatively impacting the water quality (Interviewee 8).

Instances of effluent discharge from industries and oil spills from gas stations in Region 4 are few; however, there have been cases where such sources of pollution have been dealt with. The use of monitoring and citizen reporting has aided in addressing such sources of pollution (Interviewee 7).

However, pollution from improper sewage disposal remains a problem in the Region. Improper land-use planning plays a role in this, because people are not properly policed during the establishment of homes. Squatting along the drainage canal reserves are common throughout the Region, and outhouses (outdoor toilets) are often built near the waterways (Interviewee 7). Only the central city area has a central sewerage system. This sewage, however, is not treated prior to disposal into the ocean. In other parts of the Region, sewerage is collected in individual house systems. (Interviewee 5).

Improper waste management leads to blockage of the drainage and irrigation systems and therefore contributes to the pollution of the water resource when these systems overflow (Interviewee 3).

The quality of water distributed to consumers is a concern in the Region. While the water might be treated at the point of extraction, the quality that reaches the end user is often below the drinking water standard for consumption. This can be attributed to ageing infrastructure and infiltration due to low water pressure (Interviewee 5).

Some of the water provided to consumers, such as in the rural areas of the Region, are not treated before distribution (Interviewee 16).

4.4 Understanding threats related to water quantity in Region 4

The respondents identified seven main threats to the water quantity of Region 4: floods, insufficient drainage capacity, urban development, groundwater mining, water shortage, climate change, and climate variability. These are further developed in Sections 4.4.1 to 4.4.5.

4.4.1 Floods

Flooding is a major threat to freshwater in Region 4. Several factors contribute to flooding in the Region. These are soil type, weather patterns, drainage capacity and high tides. Increases in impermeable surface area have resulted in increased runoff. This affects the drainage capacity; for example, the drainage system in the central city area is designed to withstand 1.5 inches of rainfall during a 24-hour period (Interviewee 10), but during intense rainfall periods the system drains more water than it is designed to (Interviewee 4). Climate change and climate variability, such as the increase in the intensity of rainfall, contribute to flooding in the Region (Interviewee 8).

Most of the floods in Region 4 are due to storm runoff. To better understand and manage this challenge to the freshwater resources of the Region, several components of the flooding issue need to be addressed. Firstly, an understanding of the drainage capacity is needed, especially for the central city area of the Region. The drainage system in Georgetown can withstand approximately 1–2 inches of rainfall during a 24-hour period. Rainfall intensity higher than this results in flooding of the city. The second component needed is a comprehensive management plan to assess challenges (Interviewee 3).

Frequent flooding has created a phobia to water in the Region (Interviewee 4). This fear has resulted in a reactive management approach, where the main objective is to discharge excess water in the shortest possible time (Interviewee 8). It is believed that this flood phobia phenomenon worsened after 2005–2006 when the Region experienced what was called a "great flood" (Interviewee 5). No thought is given to management approaches that might consider using the excess water in some form to benefit the Region (Interviewee 12).

In the rural parts of the Region flooding occurs not only because of natural events, such as high tides and intense rainfall, but also because of human interventions. For example, conflicting use and water requirements have resulted in flooding, where the user in the upper reaches of the river diverts water to suits his requirement, resulting in flooding for the lower river basin users (Interviewee 4).

Flooding affects the Region's economy, but the duration of the flood (that is, the period flood waters remain on the surface of the soil affects the various sectors differently). For example, the shorter flood periods have a greater impact on the financial stability of the central shopping districts because it not only damages their goods, but also affects their sales percentage since consumers are not comfortable shopping in flood conditions. For the farmers, depending on the

type of farms the period of flood affects them differently. Vegetable crop farmers (farmers of leafy vegetables) are affected by floods that last more than 24 hours, whereas rice farmers and sugar farmers, for example, as well as some fruit farmers, are only affected by floods that have a 36-hour or longer period on the soil (Interviewee 4).

The technical capacity to predict the possibility of flooding in the Region is limited. The department responsible for weather forecasts currently has no practising hydrologist on staff. As stated before, the flooding of Georgetown is generally fluvial, because of intense rainfall. While it is easier to predict the possibility of flooding due to the rivers overtopping their banks during high tides, it is not as simple to predict flooding due to intense rainfall. This situation is further impacted when high tides and intense rainfall coincide, because this increases the probability of flooding. But in the absence of flood-mapping, water resource managers in Region 4 are limited in the management options available to address flood impacts (Interviewee 4).

Although recent maintenance changes, such as regular cleaning of the drainage system in the city area, have resulted in an improvement in the drainage capacity, flooding still occurs, but the duration is shorter and it now requires longer rainfall periods for flood waters to exceed the drainage capacity. This was not the case during the 2005–2006 flood. This incident was beyond the capacity of all systems; sewerage systems overflowed and the drainage system was overwhelmed (Interviewee 5).

Cash-crop farmers are those most affected by flooding, especially during the months of December and January, the year-end rainfall period (Interviewee 6).

The capital city, Georgetown, which is the central city area of the Region, is the area most frequently affected by floods. It is below sea level, and thus frequent flooding occurs during intense rainfall and high tides. The Region 4 area can be considered a basin (Interviewee 6).

Soil type also contributes to flooding in the Region. The dominant soil type along the east coast area and the city area is of the 2:1 type clays. This soil type has swelling and shrinking characteristics, where the soil shrinks during dry periods and expands during wet periods. During rainfall, the surface soil swells and closes all its pores, forming a seal, and so preventing further water from being absorbed by the soil. Therefore, the absorptive capacity of the soil contributes to flooding (Interviewee 6).

The lower east coast area of Region 4 is another area of the Region affected by flood. The clay soil type contributes to the frequency of flooding in this section of the Region. The east bank and highway areas are composed mainly of a sandy soil type that drains water easily. The areas that flooded easily in the Region were especially evident during the 2005 flood (Interviewee 6).

Pumps and outfall sluices have been installed through the Region to increase runoff capacity. However, heavy siltation at the outfall channels during the dry periods results in flooding at the onset of the rainy season. Cleaning the outfalls during the dry period is not sustainable because the channels are blocked within 24 hours of clearing the channel (Interviewee 8). It is suggested that groynes, engineering structures, would trap the silt and prevent it from accumulating at the entrance of the outfalls (Interviewee 10).

The drainage system cannot withstand the amount of rainfall that the regions gets every year (Interviewee 12).

A water table close to the ground surface also contributes to flooding (Interviewee 12B).

Effective management plans need to be developed and implemented to address the flooding that Georgetown experiences (Interviewee 15).

4.4.2 Insufficient drainage capacity and urban development

The age and capacity of the existing drainage and irrigation system as well as the distribution system for domestic water supply also contributes to the poor management of water resources in Region 4.

Drainage, especially in Georgetown, was not built to accommodate the current runoff that it is required to sustain. This, along with poor maintenance of the system, has resulted in flooding of the city during rainy seasons. It should be noted, however, that due to an improvement in the maintenance schedule, the city now only experiences flooding during prolonged heavy rainfall and when the rainfall coincides with high tides. The city drainage system now has a faster runoff rate but while this might be good for agriculture, since the water is not on the land for a prolonged period to affect crops, it is still a major issue for business owners because any instance of flooding results in economic loss.

Region 4 has become more of an urban area over the years. Changes in land use – farming areas being declared housing areas – connected to urban development have affected Region 4 drainage capacity (Interviewee 6). Because of these changes there is an increase in the impermeable surface in the Region, causing an increase in the rainfall runoff and less infiltration into the soil. This affects the runoff capacity of the drainage system, because the drainage network cannot accommodate the increased runoff (Interviewee 12). These insufficient drainage capacity challenges, however, occur predominantly in the central city area, Georgetown (Interviewee 10). Other challenges of the Region's water drainage are related to the soil type and its water-holding potential, which affects crops when there is prolonged rainfall and the drainage system reaches its discharge load (Interviewee 4).

Improper management and maintenance of the drainage network is another contributing factor that limits the flow capacity of the drainage system (Interviewee 12). Aquatic plants and garbage block the drains, reducing the flow capacity of the system (Interviewee 3). Machines used to improve drainage in the Region, such as pumps, often do not function when they are needed, and this contributes to the Region's inability to sufficiently drain or irrigate when necessary (Interviewee 6).

4.4.3 Groundwater mining

The current groundwater usage pattern is a threat to Region 4's freshwater availability, because there is no official data indicating the capacity of the coastal aquifers (Interviewee 8). The last studies to assess the freshwater resource of the entire country were done sometime in the 1970s (Interviewee 2.) No other studies have been done since then. Additionally, the recharge locations for the aquifers have never been verified (Interviewee 10). Groundwater mining, extracting water from the aquifer faster that it is being recharged (Interviewee 11), is a major threat to the Region's freshwater resource and should be addressed by the development and implementation of appropriate water management policy (Interviewee 2).

The unavailability of data has contributed to this issue, because there is no established mechanism to collect and analyse groundwater data (Interviewee 2). All the groundwater wells that supply domestic water in the Region are constantly in production (Interviewee 19) and therefore cannot be used to collect reliable data for analysis of the groundwater resource (Interviewee 11). There was a groundwater well that was established as an observation well; however, due to technical complications, that well has been closed and no other monitoring well has been established since (Interviewee 4).

Because groundwater usage is not being monitored, groundwater mining becomes an issue. Although groundwater is readily available now (Interviewee 10), the lack of recent data regarding the status of the groundwater resource affects the ability of the Region to sustainably manage this resource. A dependency on data that is 50 to 60 years old will not provide an accurate picture of the status of the groundwater resource. Recent data is necessary (Interviewee 2) to develop a long-term management plan to ensure water availability for the next 100 years (Interviewee 10).

There has been an increased dependency throughout the Region on groundwater as the source of freshwater. This further emphasises the need to monitor the usage of this resource (Interviewee 12). The area that is estimated to be the recharge zone has experienced a change in land use over the years. Deforestation has increased, which has the potential to increase surface runoff and reduce aquifer recharge rate (Interviewee 12), thereby decreasing the Region's groundwater quantity. Thus, an understanding of the changes and fluctuation of the groundwater level is necessary (Interviewee 11).

4.4.4 Water shortage, insufficient storage capacity and the water–energy nexus: energy cost affects availability

The general population have a concept that "the Land of Many Waters" will always have water available. This results in a culture of water wastage. While attempts have been made by several institutions to educate people about the importance and simple methods of water conservation (Interviewee 12B), the need for efficient use of water is not fully realised by the general population (Interviewee 5).

Energy cost and energy sources affect the availability of water in Region 4. The energy–water nexus affects all water users, including farmers who use private pumps to supply irrigation water to their farms (Interviewee 6); the private sector that requires water to ensure their various

business processes are completed; and domestic users who desire water twenty-four hours a day. Unless your water system is connected to a generator, water is not available for use during periods when the power is off (Interviewee 5).

Additionally, other factors, such as climate change and variability, pollution and urbanisation also contribute to water shortage in the Region. Because of growing demand for water, the existing groundwater wells cannot satisfy the freshwater demand of the Region (Interviewee 13). This has resulted in the need to ration water use in the Region where water is available during specific time periods: morning, midday and evening (Interviewee 12).

Vandalism of the domestic water distribution system, poor installation and leakage are other contributing factors to a disruption of the domestic water supply (Interviewee 12). Leakage can be linked to the age of the distribution system, because these systems were installed several decades ago (Interviewee 5).

4.4.5 Climate change and climate variability

Climate change and climate variability will negatively impact the Region's freshwater resources (Interviewee 3). However, its impact on the availability and quality of the Region's freshwater resources is not fully understood (Interviewee 8). Therefore, an efficient water-use pattern is not readily adopted. This is further complicated by the general perspective that Guyana, "the land of many waters" cannot have a water availability and quality problem. This thinking persists, even with the regular El Niño drought periods and la Niña excess water periods the country experiences (Interviewee 2).

4.5 Understanding threats related to water management in Region 4

The respondents identified four main threats to the water quantity of Region 4. These are methods of communication, conflicting use, limited financial resources, and limited human resources. They are further developed in Sections 4.5.1 to 4.5.3.

4.5.1 Methods of communication

Methods of sharing information with the public and fellow water resources managers in the Region include public notices in the local newspapers, mobile text messages, emergency contact numbers (Interviewee 7) and, where available, institute websites. Each of these methods, however, has its limitations and challenges.

Mechanisms for reporting or sharing information between agencies do not allow for the appropriate actions to be taken at the right time in emergency situations such as flooding (Interviewee 5). For example, the weather forecasters might have information indicating the possibility of flooding in the Region. However, the agencies that are responsible for responding to such alerts might not be able to respond effectively because the alerts are sent outside their working hours (Interviewee 4).

There are also challenges in establishing a proper warning system to provide timely information to the public. For example, one of the methods used was mobile text messaging. This system, however, was not efficient because it was not possible to target Region 4 mobile users only, because the distribution of mobile numbers is not region specific. This resulted in receivers disregarding flood warnings (Interviewee 4).

This difficulty of receiving and reacting to the information provided also exists between the consumers and the domestic water distributor. Reporting of issues related to water distribution,

such as damaged lines, are not processed to address the problem in a timely manner. This contributes to water shortages (Interviewee 12B).

Additionally, there is no sharing of information between researchers and policy makers, because no forum has been established to facilitate this form of communication and information sharing (Interviewee 5).

4.5.2 Limited human and financial resources

While many of the respondents believe that limited financial resources affect the management of the freshwater resources of the Region, there is disagreement as to whether there are limited human resources and technical capabilities throughout the Region. For example, Interviewees 11, 12 and 14 all think that the Region possesses the necessary technical capacity to sustainably manage its freshwater resources, because there is continuous training related to water management. However, Interviewees 7, 8 and 10 suggest that there is a lack of both financial and human resources, because while people are trained in areas related to water management, retention of such skills in the Region is low. A main factor mentioned for this low retention is unsatisfactory remuneration (Interviewee 10).

There are limited financial resources for management of freshwater in Region 4 (Interviewee 3). To address this limitation, several solutions were suggested by the respondents. These include an increase in rates and taxes (Interviewee 6), an allocation for water management in the national Budget (Interviewee 8), and funding from international organizations or donor agencies (Interviewee 11).

Limited financial resources will affect the Region's ability to maintain its freshwater management plans (Interviewee 3). This limitation, coupled with the misappropriation of funds,

results in lack of financial resources being a threat to the sustainability of the freshwater resources (Interviewee 8).

Another method suggested to address the financial threat to the freshwater resource is the implementation of a licensing system for access to water, and relevant water quantity and quality data (Interviewee 8).

4.5.3 Conflicting use

There is often competition between users for the freshwater resource in the Region. Farmers have been known to divert water to supply their needs, without considering the needs of other farmers and users (Interviewee 4).

Other conflicting use includes using the same resource for domestic purposes and washing of vehicle. This has created conflicts between the two groups because oil pollution from the vehicle has affected the ability of other users to use the freshwater resource for domestic purposes (Interviewee 5).

4.6 Water policy issues in Region 4 from the stakeholders' perspective

Although there are many laws that address various aspects of water management and governance in Guyana, including the main act – the Water and Sewerage Act 2002 – there is no national water policy to address water challenges. Inadequacy in addressing current issues, and a need to understand the future water availability and quality challenges for Region 4 create the need for the relevant stakeholders to better understand the water policy situation in the Region.

The semi-structured interviews conducted as a form of data collection for this research have allowed the stakeholders to present their views on the shortcomings of the policy environment

to address the challenges facing the water sector. The following is a presentation and analysis of the major themes identified by the participants.

Water policy and governance in Guyana has several challenges ranging from the availability of resources to the lack of a water policy. The following is a list of issues identified by the stakeholders who were interviewed as part of the data collection process for the development of this research and to answer the main research questions.

4.7 Research questions

1) How are the water threats of Guyana outpacing existing water management policies?
2) Where are the critical policy gaps in the existing legislation that deals with water management?
3) Could an adaptive integrated water resource management approach effectively resolve the existing policy gaps?

The interviews were analysed to identify issues with water policy and governance in Region 4 and to develop options for addressing policy gaps. The issues identified from the semi-structured interviews can be grouped into two main themes: policy development and implementation, and governance structure. These themes are further subdivided into smaller themes as presented in Figure 6:

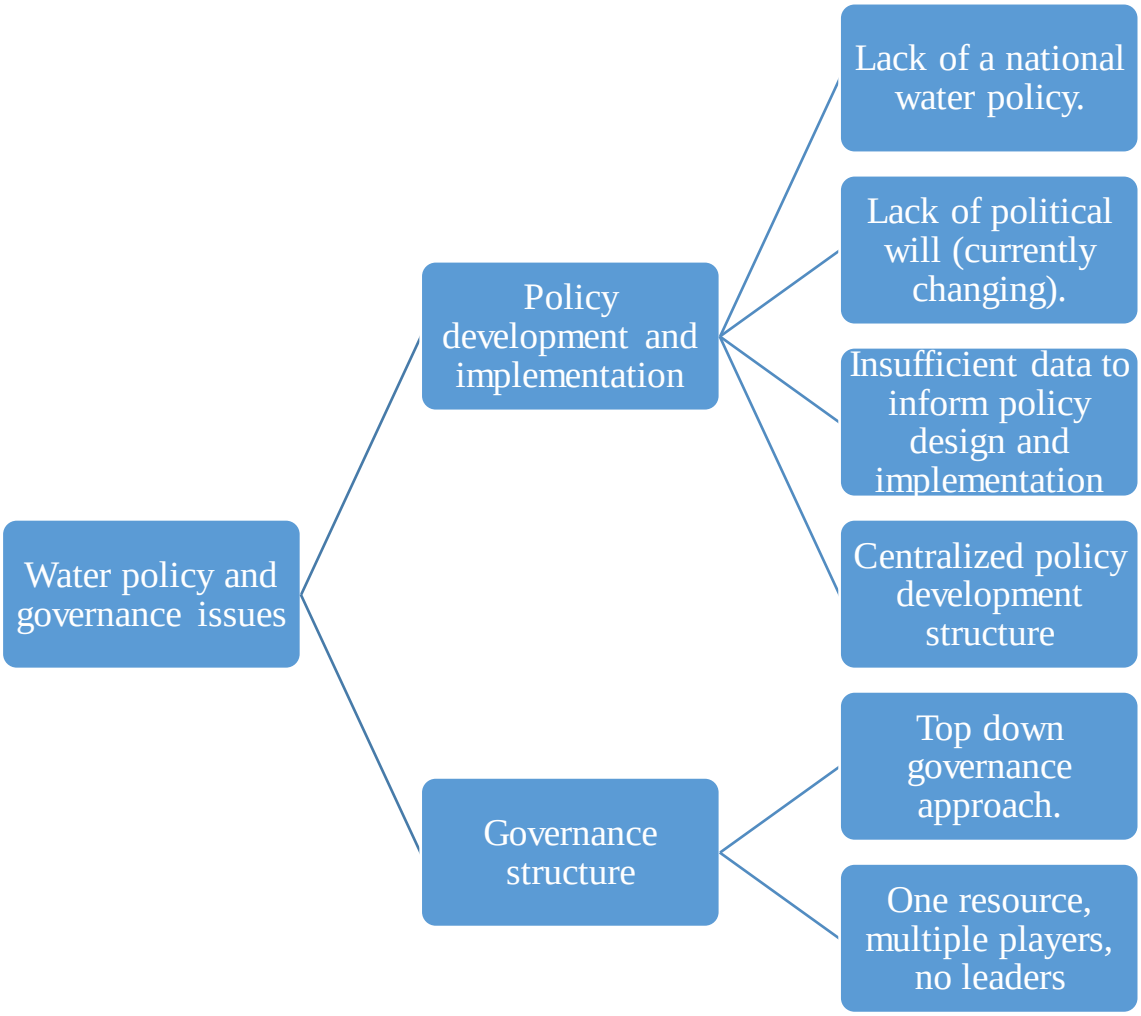

Figure 6 Water Policy and Governance Challenges in Region 4, Guyana.

4.8 Policy development and implementation

During the literature review it was identified that although several acts exist for the management of water in Guyana, there is currently no national water policy. This was identified as one of the major challenges to addressing the water challenges in Region 4. This was confirmed by several of the participants as a major issue for water management, because, as stated by one of the interviewees, "a water policy will help to enforce the legislation", and therefore help to improve water management in the Region.

4.8.1 Lack of a national water policy

As stated in the introduction section of this thesis, Guyana does not have a national water management policy. However, Guyana's national 2017 Budget has allocated funds for the development of a national water policy. The first stage of this process is the establishment of a National Water Council. This stage is currently in the process of being finalized (Interviewee 14).

The lack of a water policy is therefore one of the major issues contributing to inefficient water management in Region 4 (Interviewee 2), because, although the resource has multiple agencies involved in various aspects of management, the execution of the mandates of the Water and Sewerage Act 2002 varies in the absence of a policy; that is, each agency interprets and implements the legislation differently, resulting in overlapping responsibilities (Interviewee 2). A water policy will therefore help to enforce the legislation, thus improving water management in the Region (Interviewee 8).

4.8.2 Lack of political will for the development and implementation of a water policy (currently changing)

Lack of political will is a major contributor to the inefficient management of the freshwater resources of Region 4 (Interviewee12-B). Since the enactment of the Water and Sewerage Act in 2002, there have been various attempts by government in support of the execution of the mandates of the act. For example, the previous administration commissioned the development of a national water policy; however, in the absence of a National Water Council the policy was not submitted to Parliament and has not been implemented (Interviewee 2). While there is no policy now, the current administration has budgeted for other aspects of water management such as sewage treatment, so there currently seems to be more political interest in the management of the water resources of the Region (Interviewee12-B).

Political will has positive effects on water resource management. Changes in the maintenance schedule of the drainage system of Georgetown has resulted in an increase in the runoff capacity of the drains; while flooding still occurs, the water does not remain on the land surface for a long period and the system is no longer easily overwhelmed by short rainfall periods. It now requires longer, intense rainfall to result in flooding that overwhelms the drainage system (Interviewee 5).

These findings agree with the findings of the literature review and the document analysis, that the absence of a water policy has contributed to the present ineffective management of the Region's freshwater resource.

4.8.3 Lack of data to inform policy design and implementation

Data availability and data sharing is a major contributor to the poor management of freshwater in Region 4. Regarding data availability for informing policy development and design,

the need for baseline data is important because this help to inform standards and guidelines (Interviewee 5). Data to inform decision making is now being generated (Interviewee 16). However, in the absence of local baseline data, basic guidelines, such as those provided by the World Health Organization (WHO), can be adopted to inform policy design in Guyana until enough data is available to develop specific guidelines for water resource management (Interviewee 5).

The lack of data affects the management of water quality and quantity in Region 4. For example, the recharge zone for the coastal aquifers has never been confirmed; there is no data to support the assumption that the area identified as the recharge zone is correct (Interviewee 10), and the capacity of the coastal aquifer – the aquifer that supplies water to 90% of the country's population – is unknown (Interviewee 13). Therefore, water users are unsure if they are mining water (extracting faster than the recharge rate) or not (Interviewee 11). Additionally, because there is no policy that clearly defines the roles and responsibilities of the various agencies, there is no requirement for agencies to share information, and this has resulted in duplication of activities, thus exhausting the limited human and financial resources of these agencies (Interviewee 16).

While some data might exist (for example, the number and location of groundwater wells), the sharing of this data between agencies might not occur, thus affecting the way the resource is being managed (Interviewee 4). It is a common belief of the interviewees that this issue can be addressed if there is a national water policy, but the way forward for developing an effective policy with the data unavailable is not clear.

4.8.4 Centralised policy development and implementation structure

It should be noted that the policy environment in Guyana does not allow for the development of regional policies (Interviewee 2). Policies are centrally developed; that is, any

policy developed for the management of any resource is done by central government and implemented regionally. Administrative regions do not develop regional policies.

The lack of a water policy is therefore one of the major issues contributing to inefficient water management in Region 4 (Interviewee 2), because, although the resource has multiple agencies involved in various aspects of management, the execution of the mandates of the Water and Sewerage Act 2002 varies in the absence of a policy. That is, each agency interprets and implements the legislation differently, which results in overlapping responsibilities.

The current governance structure supports the development of national policies that are implemented by the responsible authority throughout the country (Interviewee 7). These governing bodies are centralised with departments in the various administrative regions (Interviewee 7). There are ten administrative regions (Interviewee 1). It should be noted, however, that not all the regions receive the same level of available services. The regions closer to the capital city benefit more from the water management services offered by the various agencies

4.8.5 Governance structure

This section presents the governance challenges of Region 4 that were identified by the respondents during the semi-structured interviews: top-down governance and overlap of responsibilities.

4.8.6 Top-down governance approach

Governance of water resources in the Region is done using a top-down structure. This governance structure involves both the institutional arrangements for the management of the resource and the establishment of the appropriate management scales, such as a river scale management policy versus catchment scale policy (Interviewee 2).

The top-down governance structure allows for policies and mandates to be developed by leaders in senior positions and implemented by lower level staff. An example of such a governance structure is the management structure that is present in most of the institutes responsible for water resource management in Region 4. This structure has at its top level a board of directors, who decide on management policies and make decisions to implement major changes. The next level of management normally consists of specialists, such as engineers who supervise the implementation of policies. The final level of management might consist of stakeholders who would implement the changes, such as water users' associations (Interviewee 1).

This top-down governance structure has been successful to a certain degree in some areas of water management. For example, there has been an increase in the percentage of collection in drainage and irrigation rates for some parts of Region 4, because of the method implemented for the management of the drainage systems, where the farmers are given preferential contracts to maintain the drainage and irrigation system in their area and they collect and use the rates for such services (Interviewee 2). However, collection of rates for these services are still not above 50% (Interviewee 10).

Certain aspects of this governance system have reduced the success rate of sustainable water management in the Region. For example, because there is limited participation from the community level in the decision-making process (Interviewee 5), management policies are often not accepted, and in instances when they are accepted, they are not implemented correctly because of limited understanding of the policy objectives (Interviewee 2).

The governance approach does not allow for cross-sector and cross-level collaboration and solution development. This could result in management policies not being accepted or not being implemented correctly (Interviewee 2).

The current governance structure also creates the issue of "turfism", where agencies focus only on their responsibilities, without considering the possibility of shared responsibility and collaboration for the execution of duties between the entities responsible for the management of the resources. This hinders collaboration and negatively impacts the Region's ability to sustainably manage its freshwater resources, because the limited resources that, if used collectively could accomplish more, are now being used to duplicate tasks among the different entities (Interviewee 2).

Top-down governance does not allow for the incorporation of local knowledge to inform decisions, policy development and its implementation. Implementation of a bottom-up governance approach will improve the management of the Region's freshwater resource, because it will provide a platform for the sharing of knowledge, experience, information and technology, and these will better inform policy design. This will also provide the legal authority to community members to implement decisions (Interviewee 5).

A better understanding of the collaborative process is needed in the Region. While some level of interagency collaborations exists during the execution of duties related to water management (Interviewee 7), collaboration in decision making is limited. For example, decisions regarding the appropriate time for irrigation (Interviewee 9), or irrigation rates (Interviewee 6), are often not made, or they are decided through a process of consultation. These decisions are therefore decided by the high-level management and presented by the lower level management.

Institutional structure also contributes to top-down governance of freshwater resource management in Region 4. There is no established entity or council that has the governing authority for the water resource in the Region (Interviewee 11). So, while management responsibilities of the resource might be shared between departments that are under the direction of a common

ministry, this is not the case with all the institutions, and institutional mandates take precedent over collaboration and resource sharing (Interviewee 8).

4.8.7 One resource, multiple players, no leaders

The freshwater resources of Region 4 are managed by several entities. For example, the National Drainage and Irrigation Authority (NDIA) is responsible for drainage and irrigation of farm lands (Interviewee 10), Guyana Water Incorporated (GWI) is the national domestic water supplier (Interviewee 13), and the regional and city councils are responsible for maintenance of the secondary non-agricultural land-drainage systems. Despite this, there are instances when the responsibilities of the city council and GWI are shared by NDIA (Interviewee 10). While this assistance to other agencies is not seen as an issue, it has been observed that in the absence of a policy there is no clear definition of the roles and responsibilities of the various agencies regarding water management (Interviewee 11). No one entity has the leadership role in water management and this has resulted in gaps in management. For example, in several cases of emergency response, preventative measures were not taken by one agency, because they were under the impression that another agency would respond.

Results-Document Analysis

4.9 Introduction

The analysis of relevant legislation forms part of the results section of this research. During the document analysis of existing legislation related to water management in Guyana, approximately 23 pieces of legislation were identified that address some aspects of water governance throughout the country. The management system that exists in Guyana is centralised, therefore no region-specific water management legislation exists. The main legislation for water

management is the Water and Sewerage Act 2002. This act provides for the establishment of a National Water Council and a National Water Policy with the objective of establishing a sustainable water governance and policy management system. For the scope of this research, the analysis focuses on six pieces of legislation: the Water and Sewerage Act, the Water Commissioners Act, the Guyana Water Authority Act, the Environmental Protection Act, East Demerara Water Conservancy Act and the Drainage and Irrigation Act. As stated before, the Water and Sewerage Act was selected because it is the principle national legislation that mandates water governance and policy; the Water Commissioners and Guyana Water Authority Acts were selected because as per Part XIII (91) (3) of the Water and Sewerage Act these two acts shall be considered as part of the Water and Sewerage Act 2002. Therefore, any analysis of existing legislation on water policy and governance should include these two acts as extensions of the Water and Sewerage Act. The rationale for analysing the Environmental Protection Act for this research is because the main water management legislation, the Water and Sewerage Act does not specifically address environmental aspects of water management. Therefore, any analysis that seeks to identify gaps in existing legislation to address current and future water challenges in Region 4 should include this piece of environmental legislation.

The analysis was conducted by first reviewing the structure and content of the selected legislation. This was done to better understand the functions and objectives of the different legislation. Following the content review, the three pillars of IWRM were used as a lens to identify the strengths and weaknesses of the existing legislation in addressing the water challenges of Region 4. A summary of the structure, policy strengths and policy gaps of each piece of legislation is presented in the sections below.

4.9.1 Water and Sewerage Act

As previously stated, the Water and Sewerage Act is Guyana's main legislation related to water resources management. The long title of the Act reads as follows:

> "An Act to provide for the ownership, management, control, protection and conservation of water resources, the provision of safe water, sewerage services and advisory services, the regulation thereof and for matters incidental thereto and connected therewith" (Water and Sewerage Act, 2002).

The Water and Sewerage Act provides a directive for the establishment of the water management mechanism for Guyana. Its establishes the body responsible for the development of a policy and indicates the principles to be considered when the policy is to be developed. As stated in Part II (6)(4)(a) (b) and (c),

> "(4) In developing the national water policy the Minister shall take into account the following principles-
>
> (a) Water is a natural resource and should be used so as to meet the needs of the present generation without compromising the ability of future generations to meet their needs;
> (b) Water resources should be equitably allocated for the social and economic benefit of the people of Guyana;
> (c) Water resources should be protected, conserved and used sustainably."

The Water and Sewerage Act is divided into fifteen Parts and two Schedules. The parts define the responsibilities of the different agencies, department and organisational bodies that are mandated to perform various tasks related to the management of Guyana's water resources. These fifteen main parts of the legislation also provide an outline of the various systems to be considered when managing the fresh water resources, systems such as the environmental system, the social system and the economic system. The First and Second Schedules of the Act provides guidance for the establishment of the National Water Council and penalties for offences. The Act establishes

three main arms for realising its objectives. These are the National Water Council, the Hydrometeorological Department, and the Public Supplier-Guyana Water Inc. The functions of these three arms can be grouped into three main themes: policy development and implementation (the National Water Council), monitoring of all aspects of water-use impacts on quantity and quality except potable water use (the Hydrometeorological Department), and the monitoring of all potable water use and sewerage systems (the Public Supplier-Guyana Water Inc.).

4.9.1.1 Content of Water and Sewerage Act

As previously stated the Water and Sewerage Act is composed of fifteen Parts and two Schedules.Part I is the preliminary section of the Act that provides definitions for certain concepts contained in the legislation. The establishment and functions of the National Water Council are defined in Part II of the Act. These functions include the development, implementation and evaluation of a national water policy. The functions and responsibilities of the Hydrometeorological Department are presented in Part III. These functions include the regulation of use of surface and ground water to ensure sustainability, and the assessment of the state of the nation's freshwater resources. This section of the Act also provides for the establishment of a licensing system to govern the use of surface and groundwater. Interagency coordination is provided for by the Act. This is outlined in Part III (10). This form of collaboration is permitted through the establishment of a memorandum of understanding between the Hydrometeorological Department and any agency that the Department determine can supply appropriate data to inform management decisions. Part III Section 10 of the Act not only provides for horizontal coordination in management but also provides for the bottom-up management approach where the department can select appropriate individuals for supporting all management initiatives.

As stated in Part III (10) (2) of the Act,

> "The Department may enter into arrangements with any competent person to establish mechanisms and procedures to monitor water resources."

Additionally, the Department is responsible for notifying the relevant authorities about any possible weather-related disaster such as droughts or floods.

Part IV addresses the use and ownership of freshwater in Guyana. This section further stipulates conditions for use of the freshwater resources and parameters that should be established to ensure sustainable use of the freshwater resource. For example, Part IV (19) (1) states,

> "Any person who at the commencement of this Act operates a borehole shall within three months inform the Department of . . ."

Part V of the Act establishes the procedure for obtaining a licence for water use. It stipulates the responsibility of applicants in supplying the necessary information, such as an Environmental Impact Assessment in support of their application for a licence to use water. All costs associated with the application procedure are borne by the applicant. While objections might be made to the Department regarding any decision for granting or rejecting a licence, there is no mechanism in place to appeal the decision of the department to grant or deny an applicant a licence. The only method provided for in the Act is the method that should be used to inform applicants of a licence application decision, in the form of a letter informing applicants of its (the Department's) reason for the decision taken. Therefore, there is no opportunity to appeal any decision outside of the Department as per Part V (23). Although a licence can only be granted to nationals of Guyana, businesses or organizations that are registered in Guyana can apply for licence to abstract water for use. Part V (25) (2) of the Act states that when considering the applications for a licence to abstract water, a licence for domestic purposes is given precedence considering water availability. The validity of each licence expires after 25 years. This part of the Act further stipulates the responsibility of the water user to monitor and record water quality and quantity as per parameters

set by the Department and to report their findings to the Department on an annual basis. Annual administration and abstraction fees are issued by the Department to the water user. Section 3 states that the Minister shall set the fee to allow the Department to recover the cost incurred during the processing of the licence application. Part V of the Act also provides guidance for existing users to become legal users through the acquisition of a licence from the Department. The Act in Part V provides for the Department to take legal action against water users who do not comply with the conditions of their consent, as stated in Part V (33) (2) and (b),

> "If the action is not taken within the time specified in the notice, or any longer time allowed, the department may-
>
> (b) apply to a competent court for appropriate relief."

Drought orders is the topic addressed in Part VI of the Act. This section stipulates the parameters within which the Department should advise the Minister of Agriculture to issue a drought order. The objective of drought orders, as stated in the Act in Part VI (38) (1), is to manage the demand during periods of water availability and uncertainty in such a manner that any negative impact on the economic and environmental systems is minimal. Additionally, the drought order enables the management of the rate of extraction of existing licence holders during periods of limited availability of water. The initial period of a drought order provided for by the Act is 3 months. However, this period can be extended for a period of no more than three additional months by the minister responsible for agriculture, as stated in Part VI (41) of the Act. Although the *Minister of Agriculture* issues the drought order, the public is given additional notification from the Public Supplier.

The Public Supplier, as per Part VII (44), is granted an exclusive licence to provide potable water and sewerage services by the minister with the responsibilities for water management. This indicates that there are two different licensing systems established within the Act: one that is

established by the Department and governs licences for abstraction and use of surface and groundwater by individuals, and another separate licensing system that is used solely for the licence to provide potable water. This part of the Act defines the role and responsibility of the Public Supplier to potable water users. This section of the Act concludes by giving details for the establishment of water and sewerage services rates. The rates that consumers are charged by the Public Supplier is determined by the Public Utilities Commission. The Act further stipulates that the public should be notified using a daily newspaper of the rates for water and sewerage services. The regulation of the Public Supplier is done by the Public Service commission. The schedule for monitoring the Public Supplier performance in distributing potable water and sewerage services is determined by the minister responsible for water management. Finally, this part of the Act states that all funds required for operation and maintenance cost may be supplied by the minister responsible for water management from funds allocated by Parliament.

Part VIII of the Act outlines the legal powers and boundaries of the Public Supplier in executing its role to supply potable water and sewerage services. This section of the Act provides the Public Supplier with information regarding the steps that should be taken in notifying the public or relevant authorities before commencement of any works that might impact the public. These works include the removal of vegetation for the installation of infrastructure to provide water and sewerage services. Other works include changes to existing infrastructure such as roads or bridges. The minimum notice period that the Public Supplier must provide to the necessary authority in non-emergency situations is seven days. Upon completion of the works by the Public Supplier, the infrastructure must be repaired to its initial condition or a similar condition prior to the works performed by the Public Supplier, and to the satisfaction of the relevant authorities.

The management of the sewerage system is outlined in Part IX of the Water and Sewerage Act. This part of the Act focuses on the responsibilities of the Public Supplier in maintaining existing sewerage systems and establishing new sewerage systems. As part of its functions for establishing new sewerage systems, the supplier first must identify sewerage areas, an area designated for the establishment of a central sewerage system. This part of the Act also addresses the maintenance of sewerage systems. Permission to connect to the sewerage system is given by the Public Supplier. This section states that while it is the responsibility of the Public Supplier to survey private property sewers, the responsibilities for repairs and maintenance is that of the owners or occupiers of the property. Public collecting sewerage systems, however, are surveyed, repaired and managed by the Public Supplier.

Connection and disconnection is the focus of Part X of the Act. This section focuses on four aspects of connection and disconnection of a water user to the water distribution system. These are: the guideline for the conditions of connection to the system, the associated cost to connect to the system, disconnection for failure to pay water rates, and disruptions of water service for maintenance works. The Public Supplier is responsible for connecting households to the potable water distribution system. It also deals with the responsibility of the water user to initiate the process in obtaining access to potable water, as stated in Part X (64) (3),

> "If any property is without connection, then upon request of the owner or occupier, the Public Supplier shall have the power to make the connection."

As per this part of the Act, while it is the responsibility of the Public Supplier to maintain the potable water distribution connection to any property, the cost for such repairs shall be the responsibility of the occupiers or owners of the property. Additionally, the occupants or owners of a property are required to pay water rates. Failure to do so within a 28-day period after being served a notice by the Public Supplier of incurred water rate charges may result in disruption of water

services to the offender by the Public Supplier. Part X of the Act concludes by establishing the right of the Public Supplier to disrupt water services for maintenance to the distribution system (Part X 67 1-2).

Offences are the subject of Part XI of the Water and Sewerage Act 2002. The issues identified in this section as offences include offences such as the failure to provide the relevant authorities with the relevant data to support the management of the water resources, the pollution of water ways, the diversion of water from streams and rivers, and the obstruction of the department in completing its functions. Most of the offences that are detailed in this part of the Act focus on offences that will affect the Public Supplier in realising its functions. Instances such as depositing garbage in the sewerage system, the improper disposal of sewage, and tampering with components of the water distribution system, such as a water meter or pipe stands. There are, however, only two or three offences detailed in this part of the Act that address actions that will affect water availability and water quality. One example, as per the subtopic of the Water and Sewerage Act Part XI (79) "wasting of water" is the inefficient use of water, where the water might be allowed to flow unattended, which is an offence and has a penalty. This offence focuses on actions that can affect the availability of the water resource. The only offence that deals with water pollution in this part of the Act addresses pollution of the water storage systems that the Public Supplier has provided for the supply of potable water (Part XI) (80). As mentioned before, the only other section of the offences part of the Act that addresses some aspect of water quality or quality preservation is mentioned in Part XI (74), which, although it addresses diverting water from creeks, streams or rivers, the streams and creeks that are covered under this section of the Act are limited to those that supply water to the Public Supplier for distribution. Its major focus is on diverting

water from any water distribution network or storage facility constructed or maintained by the Public Supplier.

Part XI (74) reads as follows,

> "Any person who without lawful authority flushes, draws off, diverts or takes water from any waterworks or other work constructed or maintained for the supply of water or from any water, creek or stream whereby the waterworks are supplied shall be guilty of an offence and shall be liable to the penalties prescribed under paragraph (d) of the Second Schedule."

This section of the Act continues to provide guidelines on addressing repeat offenders, as well as offences carried out by corporate bodies.

Land acquisition is the subject of Part XII of the Water and Sewerage Act. As detailed in this part of the Act, land required for the execution of the functions of the Public Supplier can be acquired by the minister responsible for Public Works, providing the Public Supplier justifies the need for the land in question. However, should the Public Supplier not require the land after acquisition, the land shall be returned to the previous owner upon the refund of monies exchanged during the purchasing process. The Public Supplier is not permitted to sell any land acquired by the minister for its function without the written approval of the minister.

Part XIII of the Water and Sewerage Act 2002 provides for the creation of the Guyana Water Incorporated (GWI), and the dissolution of the Guyana Water Authority (GUYWA) and the Georgetown Sewerage and Water Commissioners (GS&WC). This section generally outlines the functions of GWI and the procedures for the transfer of assets to this institution. It also establishes GWI as the Public Supplier. Provisions were also made for the preservation of employees' service records upon transfer of employment to GWI. Both GUYWA and GS&WC executed their functions under the legality of their respective Acts, the Guyana Water Authority Act and the Water

Commissioners Act. These acts are now considered a part of the Water and Sewerage Act 2002 as stated in Part XIII (91)(3),

> "Notwithstanding the dissolution of the Authority and the Commissioners such of the provisions of the Guyana Water Authority Act and the Water Commissioners Act, not inconsistent with this Act and which are essential to facilitate the discharge by the Guyana Water Inc. of its functions under this Act shall be deemed to be part of this Act and shall apply to Guyana Water Inc. *mutatis mutandis*."

Part XIII of the Act further states that any conflict in giving effect to any section of the Water and Sewerage Act in relation to the Guyana Water Authority Act and the Water Commissioners Act shall be made at the discretion of the minister responsible for water. This authority of the minister to resolve difficulty in executing functions of the Act is limited to two years after the Water and Sewerage Act came into being, that is, two years after 30 May 2002.

The authority of the minister responsible for water in developing regulations to give effect to the functions of the Water and Sewerage Act is detailed in Part XIV of the Act. This section outlines the regulations that may be developed to aid the various departments or entities with responsibilities for water management in fulfilling their functions. For example, as per Part XIV (93) (j) the minister may make a regulation regarding the guidelines for the monitoring of water use.

The Miscellaneous section of the Act outlined in Part XV states the power of the Act as binding to the state. It also allows for the existing water rights, including indigenous rights, to not become unlawful at the enactment of this Act.

The final sections of the Act include two schedules. The First Schedule focuses on the parameters for the establishment and operations of the National Water Council. The chairman and the council members are appointed by the minister with responsibility for water and housing. The First Schedule indicates the minimum number of members as seven persons and the maximum

number as nine persons. The First Schedule further outlines the criteria for selecting members as persons knowledgeable in water management, hinterland regions, drainage and irrigation conservation of natural resources, engineering and environmental economics. The First Schedule also states that consultation with all consumers should be done by the minister with responsibility for water before appointing persons to the National Water Council. Apart from technical knowledge, another criterion for being a council member is not having been convicted of any criminal offence, excluding minor traffic violations. While the council can establish their own meeting procedure, the meeting frequency is stated in the Act.

The Second Schedule of the Act addresses the penalties for various offences. As per the Second Schedule, the minimum fine individual faces for any offence that has a fine applied to it is GYD10,000, which is approximately USD50, and the maximum is GYD 90,000, equivalent to USD 450. The penalties section of the Act also provides for imprisonment in the event of offences. The imprisonment time ranges from four months to a maximum of one year for any offence that has a penalty attached to it. The minimum and maximum monetary fines and imprisonment fines are doubled if the offender is a corporate body.

4.9.1.2 Water governance established by the Water and Sewerage Act

The diagram presented in Figure 7 is a schematic representation of the water governances structure established by the Water and Sewerage Act. This diagram presents the different departments and organizations, and their responsibilities and roles related to water management in Guyana.

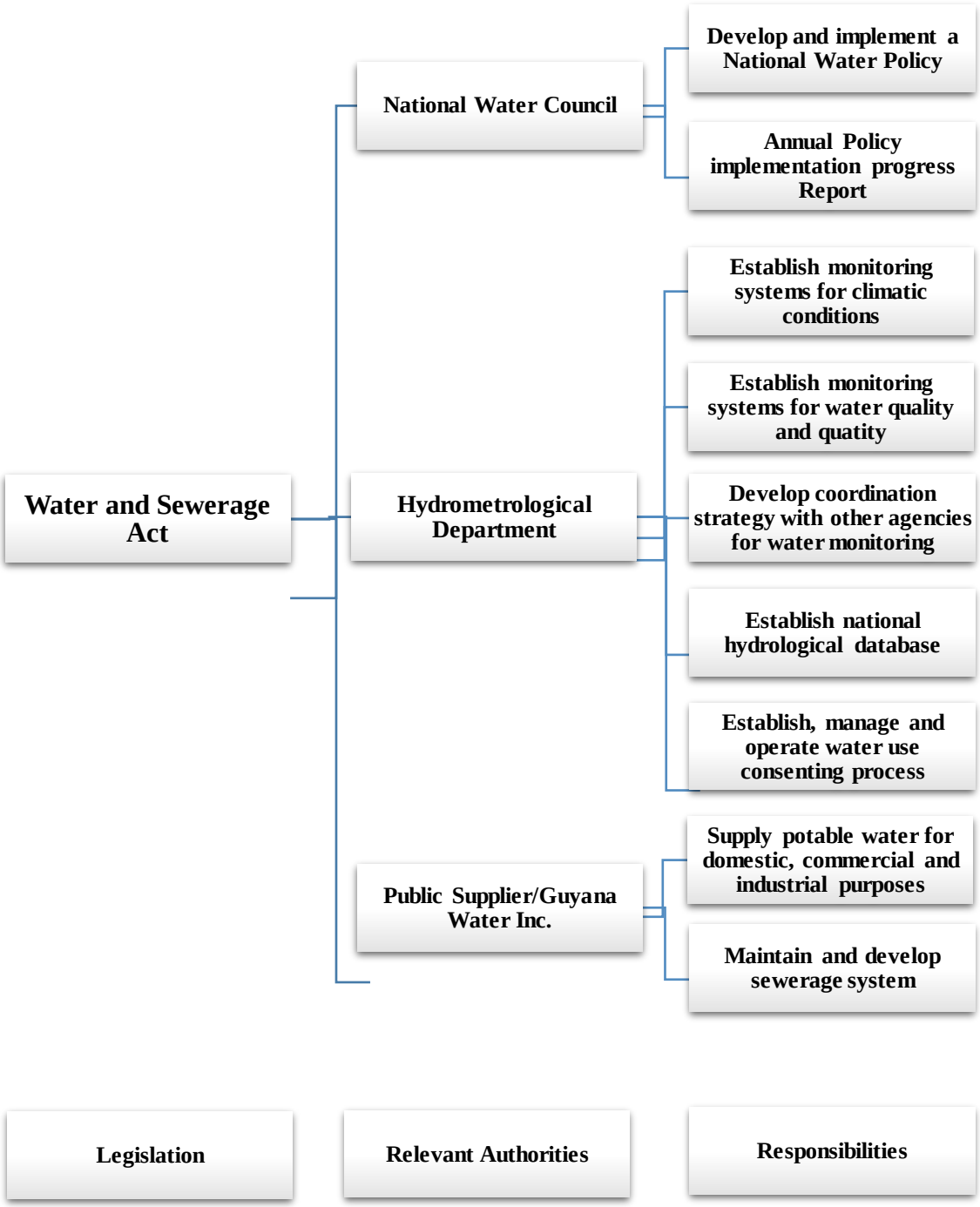

Figure 7 Water and Sewerage Act Governance Structure.

4.9.2 Water Commissioners Act

The Water Commissioners Act is a very brief legislation that was implemented to govern the conservation and distribution of freshwater in Guyana. This Act is divided into fourteen sections. These fourteen sections are further subdivided into three main areas. These are developing and giving effect to by-laws, offences and public rights. The long title of the Act reads as follows:

> "An Act to enable Commissioners appointed under any Act for regulating the conservation or Distribution of Fresh Water to make and enforce by-laws, and also to provide for the Punishment of certain offences" (Water Commissioners Act, 1886).

This Act enables the commissioner (and person or body of corporate responsible for fresh water management) to develop and implement by-laws to support the execution of their duties and functions. One focus of the Act is the penalties relating to different offences. These penalties start as low as GYD 150 for the offence stated in Section 5 (1),

> "The Commissioners may, by any by-laws made under this Act, impose on offenders against the same a penalty not exceeding the sum of one hundred and fifty dollars for each offence, and in case of a continuing offence a further penalty of four thousand eight hundred and seventy-five dollars for each day after a written notice of the offence from the Commissioners or any of their officers or servants."

Using a conversion rate of 200 to 1, GYD 150 is approximately USD 0.75. The maximum penalty for an offence under this Act is GYD 97,500 which is equal to USD 488. This penalty applied to the offence stated in Section 6 (2) of the Act which reads as follows:

> "No penalty so imposed shall exceed forty-eight thousand seven hundred and fifty dollars for a first offence, or ninety-seven thousand five hundred dollars for a second or any subsequent offence, or, in case of a continuing offence, a further penalty of forty-eight thousand seven hundred and fifty dollars for each day after a written notice of the offence from one of the Commissioners has been served on the manager of a plantation."

Terms of imprisonment are also addressed in this Act. Imprisonment terms stipulated for non-compliance of certain by-laws as per the Commissioners Act are three months. Imprisonment is given for two offences: the first is damaging water infrastructure, as per Section (11) of the Act,

> "Everyone who without lawful excuse wilfully damages any dam, trench, outfall, kroker, or sluice is liable on summary of conviction, to a fine of not less than nine hundred and seventy-five dollars and not more than forty-six thousand eight hundred dollars, and to imprisonment for a term of three months."

and the second is for polluting water in the natural systems such as trenches (drains) or canals used for water distribution section (13),

> "Everyone who wilfully fouls the water in a canal; or trench for the supply or distribution of fresh water is liable on summary conviction to a fine of nineteen thousand five hundred dollars and to imprisonment for a term of three months."

The recovery of fines by the commissioner is provided for in this Act. The case is judged by the civil jurisdiction High Court.

4.9.2.1 Governance structure established by the Water Commissioners Act

Figure 8 is a schematic representation of the water governances structure established by the Water Commissioners Act. This diagram presents the different departments and organizations, and their responsibilities and roles related to water management in Guyana under this legislation.

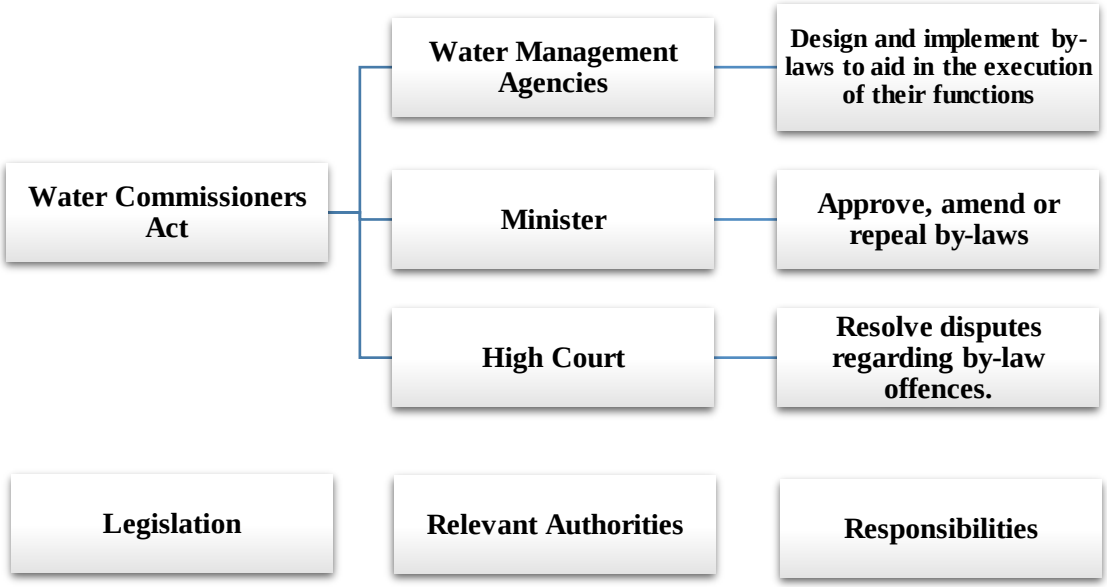

Figure 8 Water Commissioners Act Governance Structure.

4.9.3 Guyana Water Authority

The Guyana Water Authority was developed in 1972 with the main objective of establishing an institution that would manage surface and groundwater resources in relation to treatment, distribution and use, as well as developing and managing sewerage systems in Guyana.

The long title of the Act reads as follows,

> "An Act for the establishment of the Guyana Water Authority and for matters connected therewith" (Guyana Water Authority, 1972).

The Guyana Water Authority Act is divided into 31 sections, and is in Chapter 55:01 of the Book of Law of Guyana. The short title of the Act, Guyana Water Authority Act, is presented in Section 1 with the interpretation of different terms and phrases provided in Section 2 of the Act.

The establishment of the Guyana Water Authority is outlined in Section 3. Sections 4 to 31 of the Guyana Water Authority Act outlines the composition of the Authority, and the functions

and responsibility of the authority. It should be noted, however, that as per Part XIII (91) (3) of the Sewerage and Water Act, at the enactment of the Sewerage and Water Act in 2002, the Commissioners and Authority established under the Guyana Water Authority is dissolved and their functions are those established under the functions of Guyana Water Inc.

4.9.4 Environmental Protection Act

The Guyana Environmental Protection Act was developed in 1996. This Act is divided into ten parts and five schedules. The parts address different responsibilities of the Environmental Protection Agency about natural resources in the country, while the different schedules deal with the establishment of the Environmental Protection Agency, the board of directors, the Environmental Assessment Board and its functions, management of projects and penalties for failure to comply with the different mandates of the Act.

The long title of the Act is,

> "An Act to provide for the management, conservation, protection and improvement of the environment, the prevention or control of pollution, the assessment of the impact of economic development on the environment, the sustainable use of resources and for matters incidental thereto or connected therewith."(Environmental Protection Act, 1996).

Part I of the Environmental Protection Act gives the definition of the different terms used within the Act.

The establishment and functions of the Environmental Protection Agency are the subject of Part II of the Act. As per Section 3(1) of the Act, the Agency shall be governed by a board of directors. Section 4 outlines the functions of the agency, which include collaboration with relevant stakeholders in management initiatives and the establishment of management plans to ensure the conservation, protection and sustainable use of the natural resources of Guyana. Section 4 (1)(g)

further states that the agency is responsible for assessing adverse effects on the environment by any proposed development initiative and should take into consideration such effects in determining if such activities should be permitted. This part of the Act also details the responsibility of the Environmental Protection Agency (EPA), the institution established under the Act, in developing the appropriate policy (Part II (4)(2)(a)) for sustainable environmental management with the balance between social and economic development (Part II (4)(1)(j)), as well as its responsibility for setting environmental limits for pollutants (Part II (4)(2)(g)). This section also details the five environmental principles that will be employed by the Agency in the execution of its functions in managing the environment. These principles are shown below:

- the "polluter pays" principle (Part II (4)(4)(a)), where the person or entity responsible for any form of environmental pollution will pay for the damages;
- the "precautionary" principle, which allows for the possibility of a threat to the environment to be prevented in the absence of complete scientific evidence (Part II (4)(4)(b));
- Part II Section (4)(4)(c) of the Act allows for the utilisation of the "strict liability" principle which allows for penalties for non-compliance of any section of the Act;
- Part II Section (4)(4) (d and e) of the Act allows for the agency to promote the "avoidance principle" as a method for environmental management and pollution control, where the prevention of environmental damages is preferred over possible corrective methods;
- additionally, the Act allows for the Agency to employ the best technology available in the execution of their duties to prevent or correct environmental harm.

The administrative structure and functions are outlined in Part II of the Guyana Environmental Protection Act. This part of the Act gives conditions for the selection of an

Executive Director and employees for the EPA. The organisational structure as presented in this part of the Act is such that the Executive Director is appointed by the minister, and the other employees necessary for the functions of the department are appointed by the Executive Director.

Part IV of the Act focuses on environmental impact assessments (EIA), conditions for environment permits and the establishment of an Environmental Assessment Board. As per this part of the Act, the Fourth Schedule provides a list of projects that might have significant impact on the environment. These projects require environmental permits from the agency for the project to be given consent, as stated in Section (11) (1). As per Part IV (11) (2), if any proposed project is not within the parameters of the projects list supplied in the Fourth Schedule, and it is unclear whether the project will significantly impact the environment, an impact assessment should be done and the decision as to whether the project should proceed will be based on the results or findings of the EIA. In addition to the process of applying for an environment permit this part of the Act also provides the necessary content to be included in an EIA Part IV (11) (4 &5). The cost for the EIA and all associated costs relating to obtaining the EIA is borne by the developer (Part IV (11) (6&12)). Additionally, information obtained by the developer during the EIA is to be provided to any concerned party and such persons should only be charged the cost for photocopying such information (Part IV (11) (9) (b)). Part IV of the Act also addresses the cumulative effects of activities on the environment. The possibility of cumulative effects on the environment due to an activity in conjunction with other activities is another condition for requesting an EIA (Part IV (17) (1)). This part of the Act concludes with the directive for establishing an Environmental Assessment Board and by outlining the duties and functions of the board (Part IV (17) (2)). As per Section 18(2), the board is responsible for processing applications for environment permits and for determining the conditions of each permit.

Pollution control and prevention are addressed in Part V of the Act. This part of the Act outlines the duties of individuals and corporates or entities to prevent or control pollution. It also stipulates the penalties for failure to prevent or control pollution. As stated in Part V (19) (1)(a), no activity should be undertaken unless all measures have been taken to prevent or reduce any possible adverse effect. In addition to controlling and preventing pollution, Sections 20-21 of the Act also outline the requirements for monitoring any sewerage treatment plant or waste management plant. Several methods for ensuring compliance are outlined in this part of the Act. One method is the use of enforcement notices that are issued to the suspected party regarding pollution or possible pollution because of their activities. The enforcement notices provide details to the offender of the possible harm to the environment because of their projects, provides the offender with detailed guideline on how to correct the offence, and gives a period within which such actions should be taken (Section 26). Section 27 provides the other policy instrument used to ensure compliance with the EPA, by implementing the prohibition notices process. In this process, the Agency is given the authority to prevent any activity that can cause harm to the environment. The notice is served to the person responsible for the activity and states what the activity is and how it will cause harm to the environment. The notice also directs the person responsible to immediately stop the activity, when appropriate, and to take the steps provided by the prohibition notice to restore the environment to its previous state. The offending party is given a specified period within which they can appeal to the Environmental Appeals Tribunal against the agency's directive to cease all activity.

Part VI, Financial Assurance of the Act, details the methods by which a person will provide financial assurance to the agency in accordance with the stipulated conditions of an environmental authorization (Environmental permit/consent). As per this part of the Act, any environmental

authorization that has a condition of financial assurance should not become effective until the financial assurance of that permit has been complied with (Part VI (31) (4)).

Part VII provides details of the process the agency can implement for the realisation of its functions and for addressing instances of failure to comply with conditions of permits or cessation notices or prohibition notices. It outlines the parameters for prosecution of an offender in Section 32, and further provides guidelines for what should be considered general offences in Section 32, specific offences in Section 34 and the relevant penalties for these offences. This section of the Act gives specific details as to the responsibility of authorized persons in enforcing the Act, as well as the method the agency should use to provide the public with any information regarding any environment permit. Section 39 of Part VII of the Act addresses the offence of environmental harm and the appropriate penalty for such offences. Specific focus is given to environmental harm that will adversely impact the social system, that is, any pollution of the environment that is deemed harmful to humans. This part of the Act further provides guidance on the penalties that a court of law can apply to the offender, in conjunction with the penalties outlined in The Fifth Schedule for the offence. Specifically, Section 43 states that should the offender receive monetary gain from the offence, the Court may, in addition to the appropriate penalties set out by the Act, impose an additional fine equal to the estimated monetary gain the offender received because of non-compliance to the Environmental Protection Act. This section of the Act also provides information regarding the process for civil proceedings. Section 48 states that any person who has been negatively impacted due to an offender's non-compliance with the Act may sue the offender in the High Court to recover the damages. Additionally, if the damage has not occurred but is likely to occur if the offence continues, the injured party may obtain an injunction from the High Court ordering the offender to stop the project and to implement corrective actions to prevent loss.

The establishment of the Environmental Appeals Tribunal and its jurisdictions is presented in Part VIII of the Act. As stated in Section 51 (4) of this Act, the Tribunal is established to aid the Agency in the execution of its functions. It has a power to enforce equal to the powers of the High Court of Justice. The composition of the Tribunal. as stipulated in Section 51 of the Act, is five members – a chairman a vice-chairman and three other members – all of whom must be lawyers, and the chair and vice-chair each holding a qualification of ten years' experience as attorney-at-law. This section provides details as to the conditions of appointment to the Tribunal regarding salary, and established a minimum appointment time of two years. Salary and benefits of the members of the Tribunal are determined by the President. This part of the Act also outlines the procedure the Tribunal should follow in addressing appeals. The appellant will be given fourteen days' notice to appear before the Tribunal, all hearing is public and the appellant can choose to represent themselves in person or by an attorney-at-law. There is provision in the Act to appeal the Environment Assessment Board's decision after the deadline for appeals. Permission to appeal out of the specified period is determined by the Tribunal if reasonable cause is presented Section 55 (4). The Act provides for the Tribunal to resolve appeals in four ways: by dismissing the appeal, allowing the appeal, allowing the appeal with modifications, or by allowing the appeal and referring the appellant back to the Environmental Protection Agency for consideration (Section 56(3)). The Act provides for the decision of the Tribunal to be appealed on a point of law to the Court of Appeal within 21 days of the Tribunal's decision. Amendments of the appeal on point of law are given by the Court of Appeal (Section 57(5)).

Part IX details the establishment of an Environmental Trust Fund and finances for funding agency activities related to environmental protection and conservation, pollution mitigation measures, and public awareness campaigns on the issues related to environmental resources

management in Guyana, as stated in Section 58. This part of the Act further states that such funds shall be provided by Parliament, agency loans, foreign governments or international organizations, revenue obtained from penalties or funds that are payable to the Agency, as per Section 60. The trusties of the funds selected by the President, as per Section 59, are permitted to invest monies from the fund that will not be immediately used in the execution of the agency's functions, as per Section 61. Sections 62 to 67 provide additional guidelines for the use of funds and the accounting mechanism for the reporting of the yearly financial status of the agency.

Regulations for the different environmental standards, such as the concertation for pollution discharge, air pollution or regulating waste management, are the mandate of the minister, as detailed in Part X of the Act. It is the responsibility of the agency to develop and implement the appropriate regulations that would allow for the sustainable management of the natural resources of Guyana, with specific emphasis on protecting the environment from further degradation.

The Act contains five schedules. The First Schedule focuses on the establishment of the Environmental Protection Agency and provides details on the seal of the agency and the care that should be taken in securing the seal. The protection of the Agency and Executive Director against prosecution for any action taken in execution their duties and functions under the Act is stated in this First Schedule. It also stipulates that the head office of the agency should be established in Georgetown, the capital of Guyana. This therefore mandates a centralised governance structure for environmental management.

The Second Schedule gives further details for the establishment of the board of directors, its composition and functions. As per this schedule, the board is required to meet, at minimum, monthly. However, the procedure of the meeting is to be determined by the board. The maximum number of board members is 11, with a minimum number of 7, each to be given yearly

appointments by the Minister. In addition to its administrative functions in supervising the operations of the Agency, the Board is also responsible for approving environmental policies.

The functions, composition and responsibilities of the Environmental Assessment Board are outlined in the Third Schedule. The members of this board are also appointed by the Minister and should be composed of no less than three persons with a maximum of five persons. This board has a biannual appointment period. The board is required to provide a 14-day notice period to the public about any hearing.

The Fifth Schedule provides a list of projects that require environmental permits before commencement. The projects listed include the construction of any hotel, guest house or inn with more than ten rooms; hydroelectric systems; roads, harbours and airfields; dams, waste treatment facilities; importation of any waste material; keeping or release of any genetically modified organism; harvesting and utilisation of forest resources; and the extraction and conversion of minerals.

The Fifth Schedule provides the penalties for the different offences. The fines range from GYD 10,000, which is equivalent to USD 50, to GYD 2,000,000, which is approximately USD 10,000. Imprisonment is also used as a penalty. Imprisonment periods range from three months to five years. For corporate bodies, the fine is twice the maximum sum of monies for the same offence for an individual and twice the imprisonment period.

4.9.5 East Demerara Water Conservancy Act

The East Demerara Water Conservancy Act is the law that governs the management of the East Demerara Water Conservancy (EDWC), a man-made reservoir that provides freshwater for agriculture and domestic purposes and is also used for navigation within the East Demerara area.

The long title of the Act reads as follows:

> "An Act to establish the East Demerara Water Conservancy for the purpose of making better provision for the supply of water in East Demerara, to provide for the management of the conservancy and for purposes connected therewith." (East Demerara Water Conservancy Act, 1935).

This Act is divided into ten parts, sixty sections and two schedules. The different parts of the Act focus on aspects for managing the EDWC. These include directions for the establishment of the EDWC and its Board of Commissioners, guidelines for managing the conservancy, the responsibility of the Board of Commissioners, financial matters, land acquisition and property management matters, and powers of the minister. The final part of the Act deals with by-laws and regulations.

Sections 1and 2 of the Act provide definitions of the different terms used throughout the Act. Part I of the Act continues with the method that should be used to establish the EDWC and the Board of Commissioners. As stated in Section 3(1) of the Act, existing laws that govern the management of the Lamaha Canal and the Shauk's Canal will be combined with the EDWC Act and be considered a component of the EDWC system. The Board of Commissioners to be formed under this Act will be composed of ten commissioners. While the Chairman of the Board can hold office for two years, or until he resigns from the post, the other commissioners are elected on a biannual basis. This part of the Act continues to outline the duties and functions of the commissioners and the format for meeting and the record keeping of meetings. Additionally, as per Section 8 (2), in January of each year the Board is responsible for providing a report to the Minister who then presents this report to the National Assembly.

Management of the EDWC is the subject of Part II of the Act. The overall responsibility of the Board in managing the EDWC is to maintain the structural integrity of the conservancy and to

protect the surrounding areas from flooding. This is done by regulating the water levels in the conservancy, by maintaining a level that is determined by the Board to be appropriate to allow the conservancy to perform all its functions while protecting the system from collapse. This section further details the parameters to be considered in managing the EDWC. These include, but are not limited to, the discharge of excess water from the conservancy. As per this part of the Act, the Board is responsible for regulating public navigation and traffic within the EDWC system. Distribution of water for agricultural irrigation and domestic use is another main function of the EDWC to be regulated by the Board. Maintaining the necessary structures for realising these functions is the responsibility of the Board. However, the cost for maintenance is the responsibility of the persons receiving the service.

Part III of the Act focuses on the work to be executed by the Board, such as the dam to be constructed and maintained by the EDWC Board on the Demerara River. This section of the Act states that should work to be completed by the Board exceed a value of GYD 5,000, the permission of the minister is required before executing the proposed works, as per Section 20 (2). It should be noted that this Act was made into law on 14 December 1935. Considering an exchange rate of 200 to 1, GYD 5000 is equivalent to USD 25. Additionally, this part of the Act outlines the procedure to be used by plantation owners for the supply of water for irrigation. The information required by the applicant, as per this part of the Act for water to be supplied to plantations, is the boundaries of the farm and the area in acres to be irrigated.

Part IV provides details on the methods to be used by the Board in obtaining loans for the executions of its functions in maintaining the conservancy. These loans are to be repaid from rates collected from farmers and other water users for the supply of water by the Board. Rates for the supply of water are charged on an acreage basis.

However, as per Part V of the Act, rates are subsidized for land under sugar cane cultivation, and for villages and local government districts at a rate of two-thirds the calculated rate for an area more than 100 acres and one-third for areas less than 100 acres, as outlined in Section 27 of this Act. This part of the Act continues to detail the method for collecting rates and the times that rates should be paid. Accordingly, rates are to be paid annually on 1 January of each year, late payments are also accepted on 1 February and 1 August. Late payments will incur an interest of six per cent per annum. This part of the Act continues to outline the methods to be used for the recovery of rates. These include informing the Minister of Finance of rates due by any council or local authority when the payments are two months overdue. Other methods include the use of a court of law of a competent jurisdiction or by serving a notice to the offender indicating the rates due and a time by which they should be paid. Additionally, as per Section 34 of the Act, the Board may cease to supply water to any user if rates are one month or more delayed.

Land acquisition is the subject of Part VI of the Act. Any land required by the EDWC Board for the execution of its functions can be acquired following an assessment of the land and permission from the minister to purchase the land.

The method for setting a meeting of the board is presented in Part VII of the Act. This part of the Act provides for meeting notices to be sent one month prior to the actual meeting date and the preceding year's statement and revenue and expenditure of the succeeding year should be discussed at such meetings. Further explanation as to the procedure for each meeting is given in this part of the Act. For example, in Part VII, Section 40 (2) relates to the time established for a meeting to start. If the meeting is delayed for 30 minutes and a quorum (at least fifty votes) is achieved, the meeting should be adjourned to the same day, the following week.

The power of the Minister in supporting the EDWC Board in executing its functions in management of the EDWC is provided in Part VIII of the Act. The minister has the authority to direct or prevent the Board from executing any works, to establish plantation rates for water supplied, to change the rates to be paid by local council and, among other functions, to order the Board to make financial compensation to any person who has suffered loss due to any work or action of the EDWC Board. However, the amount to be compensated is determined by the High Court.

General offences and penalties are discussed in Part IX of the Act. This part of the Act establishes a fixed fine for any action that will result in pollution of the conservancy waters. For example, Section 53 (a) states that bathing, washing clothes and animals in the conservancy is an offence and shall be liable to a fine of GYD 4,875, equivalent to USD 24. Damage that impacts the structural integrity of the conservancy has a penalty of GYD 48,750, which is approximately USD 244.

The final part of the Act, Part X, focuses on the development and implementation of by-laws. This part of the Act states that the Board may make by-laws to aid in the executions of its functions and to guide its officers in performing their duties. This section of the Act also allows for by-laws that are considered inconsistent with the EDWC Act to be replaced by new regulations or by-laws.

The Act concludes its parameters for the management of the EDWC with two schedules. The First Schedule of the Act presents a list of sugar cane plantations under the district of the Conservancy. The Second Schedule provides a list of the plantations owners or representative that can vote via the district commissioner.

4.9.6 Drainage and Irrigation Act

The Drainage and Irrigation Act, No. 10 of 2004 established the National Drainage and Irrigation Authority (NDIA) and its functions. This Act repeals the Drainage and Irrigation Act, No. 25 of 1940. The new Act defines the rules of the Drainage and Irrigation Board. The long title of the Act reads as follows:

> "An Act to provide for the establishment of the National Drainage and Irrigation Authority for ensuring that water resources are located, evaluated, conserved and utilised for the greatest national advantage through appropriate water management strategies and water-use planning; to provide that the drainage and irrigation systems operated in a sustainable manner, to provide for increased farmer participation through water users' associations, local government organs, farmer associations or private entities in the planning, development, operation, maintenance and management of the drainage and irrigation services; to define the powers and duties of the Authority, and for the matters related thereto or connected therewith." (Drainage and Irriation Act, 2004).

The Drainage and Irrigation Act is composed of twelve parts, eighty-two sections and four schedules. These different components of the Act provide guidelines for the management of the drainage and irrigation systems established throughout Guyana.

Part I of the Act defines the terms used within the Act. It also provides the objectives of the Act, mainly to provide irrigation water for the development of the agriculture sector and to manage the drainage, irrigation and flood control systems. Additionally, this part of the Act provides for collaborative governance by allowing for the participation of relevant stakeholders during the development stage of management strategies.

The establishment of the National Drainage and Irrigation Authority, the NDIA Board of Directors and their functions and responsibilities are outlined in Part II of the Act. This part of the Act further details that the constitution of the board of directors allows for representatives of the Water Users Associations and regional representatives, in addition to the other technical members.

In addition to its irrigation, drainage and flood management functions, the Board is also responsible for the development and implementation of the relevant institutional policy and governance strategies of the Authority as well as that of the local and regional water management organs established under this Act. This part of the Act also allows for collaboration and coordination between the Authority and other agencies. As stated in Section 8 (1)(h), the governing body of the Authority, the Board, is responsible for:

> "ensuring the co-ordination of plans, programmes and activities between the Authority, the Sea Defence Board, Conservancy Boards and other relevant entities;"

Finally, this part of the Act states that the Authority is responsible for the development of guidelines to enable effective collaboration between the relevant stakeholders in management of the water resources.

Part III of the Act establishes that the main objective of the Authority and its board of directors is to provide water services for agricultural development. This part of the Act provides for the development of a National Drainage and Irrigation Policy to aid in the execution of its functions. Establishment of different levels of institutional governance structure for water management is also provided for in this part of the Act.

Delegation of drainage and irrigation services to other entities is detailed in Part IV of the Act. This part of the Act states that farmers should form Water Users Associations and should be given the necessary training to enable them to effectively manage the drainage areas under their control.

The administrative powers and responsibilities of the Chief Executive Officer of NDIA and the Appointments Committee are detailed in Part V of the Act. This part of the Act establishes that the Chief Executive Officer is responsible to the Chairperson. This part of the Act also details that all matters of the Board should be considered confidential and no information obtained during the

meetings should be used by any Board member for personal gain. Such an offence has a fine of GYD 10,000 and six months' imprisonment.

Part VI of the Act focuses on the functions of the Authority in relation to construction of new works and maintenance of existing structures. It basically outlines the procedure to be taken by the board about developing a design plan for a new structure and having that structure built. Additionally, in the events of flood the authority is provided with guidelines on addressing such cases. The first step is to inform the minister of the possibility of flood, the minister then gives the directives for the Authority to take all necessary actions to address the issue. Finally, the authority also has the legal right to remove, alter or rebuild any structure that is not under their authority if it is deemed necessary to enable the authority to fulfil its duties.

Compensation is detailed in Part VII of the Act. It states that persons should be compensated for land acquired by the Authority or for damages incurred by any property because of action or inaction on the part of the Authority. However, the amount to be compensated is to be determined by a magistrate's court when the amount to be compensated cannot be agreed on by the two parties.

A guideline for acquiring financial resources and accountability of finances by the Authority is provided in Part VIII of the Act. This section presents several ways for the Authority to obtain financial resources. This include from the rates and fines for services provided and from gifts and donations from other organizations, or funds allocated annually from Parliament. This part of the Act further outlines the authority of the Board in investing funds for appropriate rates of return. It also states that the Authority is exempt from taxes. Annual reports and budgets are expected to be presented to the Minister and should include a status of works and projects being executed by the Authority, and audit statements.

Part IX focuses on the financial provisions of the Authority. This part of the Act provides for the establishment of rates by the Authority. Additionally, the Authority can adjust rates on a yearly basis to reflect the cost for services provided. However, in assessing the areas to be charged, properties that have any building erected for religious or educational purposes, or burial or cremation sites, shall not be charged for services provided by the Authority.

Penalties and offences are addressed in Part X of the Act. The offences addressed are damages to any structure that affects the Authority in executing its irrigation or flood management functions, such as the unlawful abstraction of water from any irrigation system managed by the Authority, where the offender would be charged a fine of GYD 25,000 and three months' imprisonment. The same charge and imprisonment terms apply to any person that allows their farm animals to trespass on any land or structure managed by the Authority.

Part XI of the Act address conflicts of interest between any member of the board of directors or any officer of the Authority in performing their duties. It further states that should any such business of the Authority impact on any of the officers or Board members, they should inform the Authority of the possibility of conflict and remove themselves from being a part of the decision making of the matter in question. Additionally, this part of the Act provides for the development of regulations by the Authority to efficiently perform their functions as stated in the Act. The final sections of this part of the Act detail the powers of the Authority in performing its duties. For example, the Authority may lawfully survey any lands it deems necessary for executing its functions. Additionally, the Authority may legally require land owners to maintain certain structures that are on their estate. Structures such as canals, dams or sluices may be repaired by the land owner in a manner and at a schedule that the Authority specifies.

The final part of the Act, Part XII, provides for the recovery by the National Drainage and Irrigation Authority of funds owed to the Drainage and Irrigation Board. This also includes existing agreements for services or rates or loans that were established under the previous Act that are now recovered by the Authority under this Act.

As stated previously, this Act has four schedules. The First Schedule addresses the functions of the Board and its Directors. It states that every member of the Board except for the Chief Executive Officer shall be appointed for a maximum period of two years. While the Board can determine the procedure for its meeting, the Board, as per this schedule of the Act, should meet at least once every quarter. This schedule of the Act further provides for collaborative governance at the lowest appropriate level by allowing for the establishment of regional water resource management committees. The Second Schedule provides a format for the form of warrant of distress, which is a form of notification from the Authority to offenders. The Third Schedule provides a list of other laws that were cited in this Act, and the Fourth Schedule provides a list of the Declared Drainage and Irrigation Areas that were established under the repealed Drainage and Irrigation Act and which continue to be Declared Drainage and Irrigation Areas under this Act.

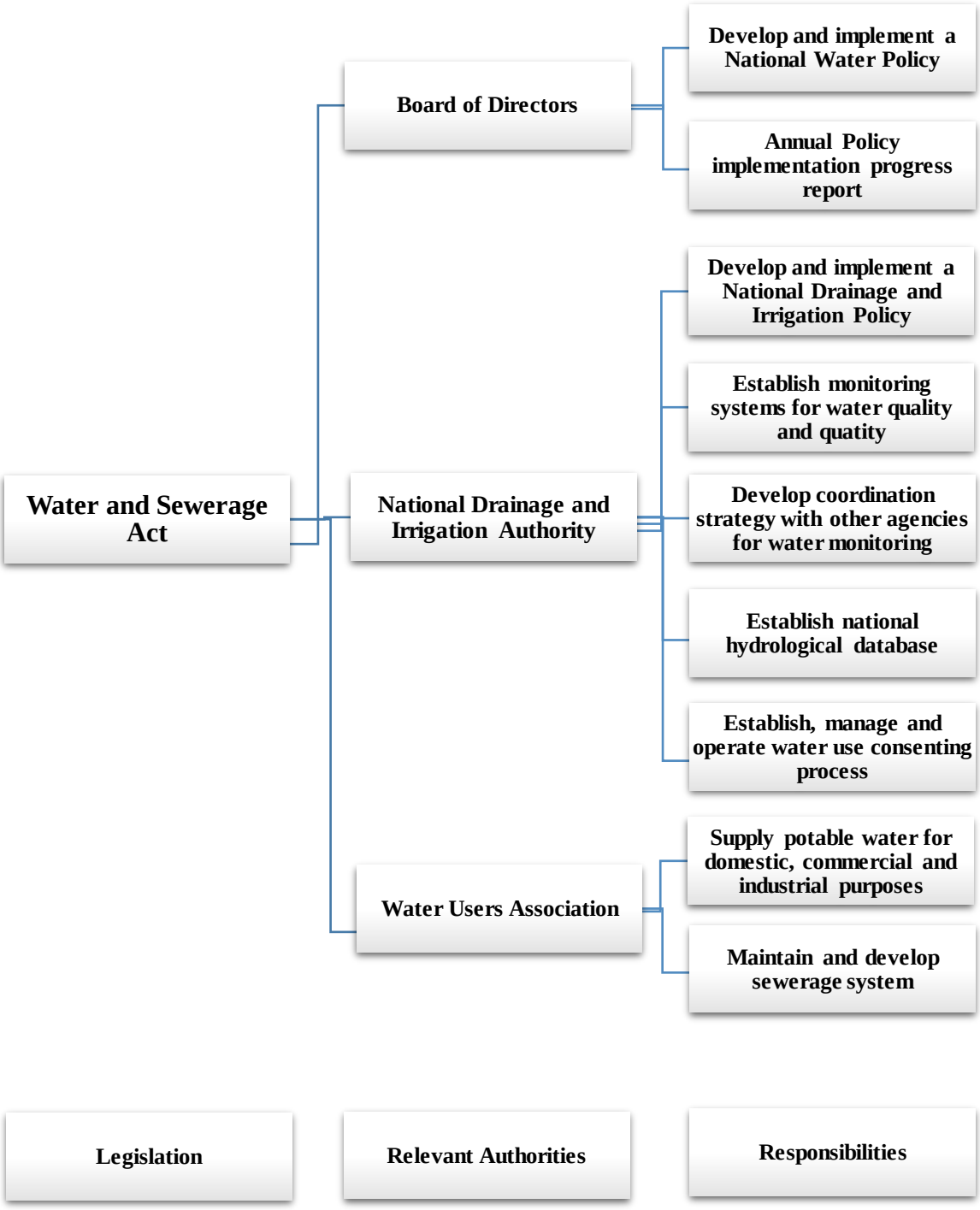

Figure 9. Drainage and Irrigation Act Governance Structure.

4.9.7 Different challenges addressed by the existing laws

This section of the analysis reviewed how the existing laws address the different water challenges identified by the respondents. The analysis focused on the main water management issues of water quality and quantity identified during the semi-structured interview sessions. These water management challenges are: flooding, which is related to the drainage capacity; pollution, which relates to waste management and salt water intrusion; water allocation, which relates to groundwater mining, conflicting use, and urban development; and climate change and variability.

4.9.7.1 Flooding

There is no flood management plan established by any of the laws. Rather the management of flood is done in a segmented manner where different agencies are responsible for managing different aspects of flood in the Region. For example, under the Water and Sewerage Act, the Hydromet Department is responsible for issuing flood warnings. Under the Drainage and Irrigation Act, the National Drainage and Irrigation Authority is responsible for flood control. However, no mechanism is established by the various laws to ensure that the relevant authorities gets the necessary information regarding flooding in a timely manner. For example, sometimes when the information about possible flooding in Region 4 becomes available its outside of the work hours of the departments that should respond to this information, therefore there is a delay between when the information is available and when it is acted upon (Interviewee 12). Interagency collaboration is therefore a policy gaps that affects the Region's ability to manage flood challenges.

4.9.7.2 Pollution

Point source pollution is addressed by the different laws. For example, the EDWC Act addresses pollution that occurs, by imposing a penalty for actions that may result in pollution of the conservancy waters. For example, Section 53 Part ix (c) states that any person who throws any

garbage such as broken bottles, oil or filth or any other contaminant into the conservancy or any reservoir shall be fined GYD 4,875. No directive is given to charge the offender or cause the offender to clean up the pollution and take action to have the water returned to a healthy state, nor are directives given to avoid causing pollution to the waters of the conservancy.

4.9.7.3 Water allocation

Of the laws that govern some aspects of allocation of the water resource, all of them use a supply-on-request method; that is, water is provided for use to anyone who makes an application in writing; for example, the Wand S Act states that all groundwater wells should be registered and any request for groundwater use should be made to the Hydromet Department which then provides a licence to the applicant to use the resource. Similarly, the EDWC Act provides water for irrigation to farmers upon request.

The EDWC Act allocates water on an application basis. Persons requiring water to irrigate their farms simply write a letter to the Board stating the location of the farm and the area in acres; the conservancy will then determine the amount of water to be delivered to the farm (Section 21 (a)). Rates for irrigation water is the same for all plantations (Section 21 (b)(ii)). This method of allocation is only limited to the plantations that have not been listed in the First Schedule of the Act Section 21.

While the application process for water use is currently simple. The laws use a first come first serve method for allocating freshwater.

4.9.7.4 Financial challenges

The different laws provide for the imposition of rates and fees, and penalties for offences and services offered by the different organizations or departments that have responsibilities for the management of the water resources of Region 4. However, the rates provided for in the Act does

not allow for the true reflection of costs to provide services, or for the cost of harm to the environment. For example, Section 29 (1) of Part V of the EDWC Act states that the sum to be paid to the EDWC Board for the supply of potable water to the City of Georgetown is GYD 6000. The lack of financial resources is one of the major hindrances to efficient water management in the Region, as identified by the respondents during the semi-structured interviews. However, the legislation that exists today is ineffective in addressing this challenge.

4.10 Conclusion

Each of the Act reviewed governs the management of different aspects of the fresh water resources of Region 4, Guyana. For example, the Water Commissioners Act and the Guyana Water Authority Act are an extension of the Water and Sewerage Act as of May 30, 2002. When combined, these Acts governs the management of surface and groundwater as well as the distribution of potable water. However, these two sectors of water are not managed by the same entity. Another example is pollution control. Pollution of the environment of which water is an extension is managed by the Environmental Protection Agency under the Environmental Protection Act. The different Acts allowed for the establishment of the relevant regulatory body to enforce the Acts. In some instances, the strategic planning instrument that is provided by the Act is not functioning. This is the case with the National Water Council, that should have been established under the Water and Sewerage Act but is currently not established. The enabling environment pillar of integrated water resources management (IWRM) is provided for by all the legislation analysed for this research. However, the scope for collaboration is limited, for example the Water and Sewerage Act allows for horizontal collaboration that is interagency collaboration for water resources management.

Additionally, the review of these laws revealed that their structure allows for the effects based management of the water resource rather than the outcome based management. That is these laws address the effects of actions or projects on water quality and quantity and not necessarily ways in which projects can be implemented to prevent harm to the resource.

The current legislation that governs the management of water in Region 4 Guyana are not addressing the current water challenges of the Region. The effects based management system established by the laws and the age of the laws are great contributors to their ineffectiveness in addressing current stresses to water management in Region 4, Guyana.

Chapter 5

Discussion

5.1 Introduction

This chapter presents a summary of the findings of the semi-structured interviews and the data analysis, and provides answers to the research questions. The answers presented from the results will be reviewed in context with the relevant literature.

5.2 How are the water threats of Region 4, Guyana outpacing existing water management policies?

Yes, the water threats of Region 4, Guyana are outpacing the existing legislation. The absence of a national water policy creates a lot of challenges for water resources managers. This is the general agreement among the respondents, who identified fourteen challenges that are currently not being sufficiently addressed by the current legislation. These challenges are listed in Sections 4.3.1 to 4.2.4. Of the water challenges identified by respondents in answering the first research question of this thesis, flooding, lack of financial resources and pollution are the three main water-management challenges of Region 4, Guyana. These findings support the water-management challenges in Guyana identified and presented in literature by Hickey and Weis (2012). Similar water challenges were identified in other developing countries by Scott, Faruqui, and Raschid-Sally (2004). The reasons identified for this inability of the existing legislation to address these challenges are the lack of a national water policy, the institutional framework within which the current legislation are implemented, the lack of data to inform the policy, and lack of financial resources to implement the policies. The analysis of the legislation also identified areas of the legislation that makes them unable to address challenges such as waste management. The water policy situation in Guyana is currently in flux. The Water and Sewerage Act allowed for the

development of a national water policy. Fifteen years after the enactment of this Act, a national water policy has not been developed. The Government of Guyana in its 2017 national Budget provided for improvements in water availability and waste management (BudgetSpeech, 2017).

The sustainable management of water in Region 4, Guyana, has been affected by the inability of water resources managers to use the planning tools provided by the different laws. Planning tools such as a National Water Council and the National Water Policy have not realised their true potential because they are still to be established, therefore the objective of the Water and Sewerage Act has not been met.

5.3 Where are the critical policy gaps in the existing legislation that deals with water management?

A review of the legislation revealed that the critical policy gaps that exist in the legislation involves the underutilization of the policy instruments provided by the Acts for water resources management. Policy gaps also exist in the institutional framework under which these instruments must function.

The existing legislation that governs the different aspect of water management in Region 4 has several gaps that affect their successful implementation. These gaps can be summarised into two main themes: the first is that the planning instruments provided by the legislation are not utilised, and the second is that instruments that are highly targeted are needed to address freshwater manage challenges in the Region.

The different legislation reviewed during this research have provided different planning instruments to achieve their objectives. For example, the Water and Sewerage Act provided for the establishment of a National Water Council. As stated previously, up to the period of this research, this council has not been established, and thus the Region's ability to address challenges such as

monitoring surface and groundwater abstraction is limited in the absence of a national water policy. This view agrees with Daily et al. (2009) who state that a natural resource management policy, when properly developed and implemented, can achieve environmental objectives, such as monitoring water abstraction to protect ecosystem services. Additionally, Ward (2007) states that the use of a policy to manage water use enables water resources managers to develop appropriate management plans for their catchments. Therefore, the development and implementation of a national water policy is necessary for sustainable development in Region 4, Guyana.

Other policy instruments such as economic and regulatory instruments are provided for by all the legislation analysed for this thesis. These instruments have not realised their true objectives for several reasons. One of the reasons that limits the success of these instruments is the capacity of the institutions to develop these instruments, such as the appropriate regulatory instruments for groundwater abstraction by the Hydrometeorological Department. A groundwater abstraction regulation would aid in changing the usage patterns of groundwater users. But limited financial and technical capacity and the absence of a water policy makes it difficult to address this water management challenge in Region 4. Institution capacity is an important element for sustainable water management and can negatively impact the ability of water resource managers to perform their functions in managing the water challenges in the Region. Incompatible institution structure also affects the ability to successfully implement economic policy instruments. This correlates with the findings of Andersen (2001) who stated in their research that one of the main reasons for the failure of the economic policy instrument for water pollution control in Germany, Denmark and France was due to the instrument being implemented in an institutional framework that did not support the economic policy instrument. In contrast, the Dutch implementation of the economic

instrument to manage water pollution was successful because of the Dutch Waterboard's management structure that allows water management at the local municipal scale.

In addition to the inability of the various departments to use the different policy instruments provided to aid enforcement of the legislation, the economic policy instruments proposed by the various laws do not address specific water challenges, nor do they allow for the true value of water to be appreciated by water users. For example, the Water Authority Act, which is now considered part of the Water and Sewerage Act, limits the minimum and maximum penalty that can be applied to any offence of any by-laws or regulations of that Act. This simply means that any activity that results in contamination of any freshwater resource under this Act will not be penalized at the true value – the cost to contain or reverse the pollution, but will be limited to a maximum value established by the Act. This, however, contradicts the Environmental Protection Act, which also governs the pollution of water systems. This Act provides penalties that will be equal in value to the damages caused by pollution.

The policy instruments employed by the existing legislation do not effectively address water challenges such as pollution or waste management, because the economic instrument used, such as penalties for non-compliance, are too small to encourage changes in behaviour. For example, Part XI Section 72 of the Water and Sewerage Act states that improper disposal of sewage is an offence and it suggests for this offence a minimum fine of GYD 20,000, which is approximately USD 100, and a maximum fine of GYD 60,000 , approximately USD 300, and imprisonment for four months, as stated in paragraph (c) of the Second Schedule of the Act. The benefit gained from non-compliance outweighs the penalty. Additionally, the instruments do not address specific challenges. As per Delacámara et al. (2013) an understanding of the water

challenge is necessary for selecting the appropriate economic instrument for sustainable management.

Of the laws reviewed for this thesis, regulation is the other main policy instrument provided to aid in the execution of the functions related to water management. This instrument has not realised its true potential, however, in addressing the water challenges of Region 4, despite some of the Acts having developed and implemented regulations, such as the Environmental Protection Act, which has allowed for the development of several regulations, namely, The Environmental Protection Hazardous Waste Management Regulations 2000 and the Environmental Protection (Water Quality) Regulations 2000. Enforcement remains an issue, again, because of limited human and financial capacity. The regulatory instrument of other Acts such as the Water and Sewerage Act have not been implemented; that is, no regulation has been developed regarding the monitoring of water use. This is in addition to the lack of appropriate institutional frameworks, namely a National Water Council, and human and financial capacity. Inability to effectively monitor the use of freshwater resources due to the absence of regulations results in the water challenges of the Region not being resolved through the existing legislation. This is in agreement with (Helmer, 2010) who found that the inability to develop and enforce regulations limits their usefulness in addressing water challenges. Additionally, Reddy (2016) states that it is important to consider the policy environment before implementing regulations for water-demand management as this also contributes to the ineffectiveness of this policy instrument in addressing water challenges.

Another policy gap is that the planning instruments that allow for management of water resources at all scales of the governance structure have not been used. While the different Acts provide for different forms of public consultation and different forms of public collaboration or interagency collaboration (except in the case of the Water Users Association established under the

National Drainage and Irrigation Authority), there is no record of a similar management strategy established under the other Acts.

5.4 Could an adaptive integrated water resource management approach effectively resolve the existing policy gaps?

Yes, an adaptive integrated water resource management (AIWRM) approach can effectively resolve the existing policy gaps and therefore address the water challenges of Region 4. This can be done by identifying and resolving the cause for the existing policy gaps. In this section, the IWRM aspect of the proposed management approach for water management in Region 4 will be assessed. The adaptive management aspect will also be assessed in the following section, and the integration of these two management approaches will demonstrate that an adaptive integrated water resource management (AIWRM) approach will effectively resolve existing policy gaps, and, if implemented, can address the water challenges in Region 4.

5.4.1 IWRM- resolving policy gaps

As discussed in the previous section, the main policy gaps in existing legislation include failure to use strategic policy instruments such as the economic instrument, the regulatory instrument and the collaborative governance framework. Factors that contributed to these policy gaps include inappropriate institutional structure, undervaluing of water resources, financial capacity, limited technical capacity, absence of a national water policy, and lack of collaboration. From these factors, we can identify the principles of IWRM, shown in Figure 10, that are currently not being properly implemented through the existing legislation: these are economic efficiency and social equity. These principles correspond to the management instrument and institutional roles – two of the three pillars of IWRM. According to Jønch-Clausen (2004), the successful

implementation of IWRM is dependent on correctly adapting the three pillars of IWRM (management instruments, enabling environment and institutional roles) to the management framework in which it is to be implemented. Therefore, the existing policy gaps can be resolved by identifying and resolving the issues that affect the management instrument and institutional roles from being used effectively, thereby improving water management in Region 4.

Figure 10. General Framework for IWRM. (GWP-TAC, 2000, p. 29)

5.4.2 Adaptive management- resolving policy gaps

The adaptive management cycle involves four factors. As each stage reaches its maximum stress point the cycle moves onto the next stage. Adaptive management, as represented by this model, allows for the management system to be resilient to changes to the system without disrupting the management cycle (Engle et al., 2011). This model when applied to the policy system will allow for the identifications of the gaps (stress to the management cycle) that needs to be addressed throughout the system to achieve adaptive integrated water resources management in Region 4, by reorganizing as the system becomes stressed.

The adaptive system model for the policy gaps (economic and regulatory policy instruments) is presented in the following section. The four phases of the adaptive system are represented by the factors that contribute to the policy gaps in the existing water management legislation (Engle et al., 2011). The cycle demonstrates that by addressing these stresses to the legislation, the policy environment will be created to enable IWRM and therefore allow the system to become adaptive, thus allowing for AIWRM.

5.4.2.1 Adaptive management learning cycle

The four factors that contribute to the policy gaps can be identified as the components of the policy learning cycle. This is in agreement with Pahl-Wostl et al. (2007) who stated that adaptive management is a learning cycle that adjusts to accommodate changes in the policy environment within which it is implemented.

From the analysis of the legislation, four contributing factors to the policy gaps were identified. These are limited financial resources, inappropriate institutional framework, lack of technical capacity, and limited collaborative governance. By understanding the links between these four factors, the adaptive capacity of the water management system of the Region will increase, thus providing a framework to address water challenges. This is supported by Pahl-Wostl et al. (2007) who stated that as a system's adaptiveness increases, management and policy is combined with learning and with increased understanding of interdependent factors such as finance, technical capacity and institution framework

The adaptive management learning cycle of the policy gaps is represented by the four factors that contribute to the policy gaps in the existing legislation that governs water policy in Region 4.

Factor 1: Financial resources. Available financial resources can limit the capacity of the system to execute its functions in managing the freshwater resources of the Region. A continued depletion of the financial resources can affect the institutional framework of the policy system, because it is costly to establish the appropriate institutional structure, within which the economic and regulatory policy instruments are to be implemented. Additionally, acquiring and retaining the necessary technical staff and instruments requires finance. If the financial resources are, or continue to become, depleted, this will affect the capacity of the agency to sustainably manage the water resources of the Region. This analysis agrees with Antadze and Westley (2010) who stated that the reorganization of resources, such as financial and human resources, is needed to successfully implement any form of management tool.

Factor 2: Institutional framework. As the stress to the financial resources continues, the impacts are felt in the institutional structure. This hampers the ability to develop the correct institutional framework for the implementation of selected policy instruments, such as the economic and regulatory policy instrument. Addressing the stress at this stage will allow the management cycle to adapt to the challenges and thus create the appropriate environment for the successful use of institutional roles – a pillar of the IWRM framework. This will have the result of enabling the water resources managers of Region 4 to address water challenges that are not easily resolved with the current institutional structure. This finding agrees with Cerna (2013) who stated that policy instruments need the enabling institutional framework to be effective. Additionally, B. K. Williams (2011) as well as Pahl-Wostl et al. (2007) state that adaptive management faces implementation challenges when the institutional framework is not favourable.

Factor 3: Technical capacity. Limited technical capacity, if not addressed, can lead to further depletion of the human resources of the institution, and therefore impact the quality and

scale of water resources management in the Region, because, staff with the appropriate technical knowledge and skill along with the relevant technology are needed to acquire the necessary data to inform policy design and implementation, and to inform management decisions. This correlates with Bostic (2017) statement that the relevant data is important to informing policymakers in four main aspects of policy making: problem definition, policy options, prediction of policy outcomes, and evaluation of policy performance. The development of an IWRM environment for water management in Region 4 can be affected, because one of the principles for IWRM management is to have sufficient data to inform policy design and implementation. The necessary technical staff and instruments needed to acquire the data required to inform policy design and implementation, and to inform management decisions. By increasing the technical capacity of staff and acquiring the appropriate technology to aid in managing the water resources of Region 4, the policy gaps will be addressed, so causing the existing legislation to achieve its objective of sustainable water resources management.

Factor 4: Collaborative governance. A true understanding of collaborative governance is needed to enable the full use of the economic and regulatory instruments of the legislation that governs water management in Region 4. Collaboration is also needed on the vertical scale to allow management at the lowest relevant scale. Addressing this factor will allow for the successful implementation of regulations and appropriate economic instrument, as these would have been developed and agreed upon during collaboration by all the relevant stakeholders.

5.4.2.2 Schematic representation of the adaptive management learning cycle

The diagram below, Figure 11, shows the relationship between the policy gaps identified from the analysis of the legislation that governs water management in Region 4, the contributing factors to the policy gap, and the principles and pillars of IWRM that are affected.

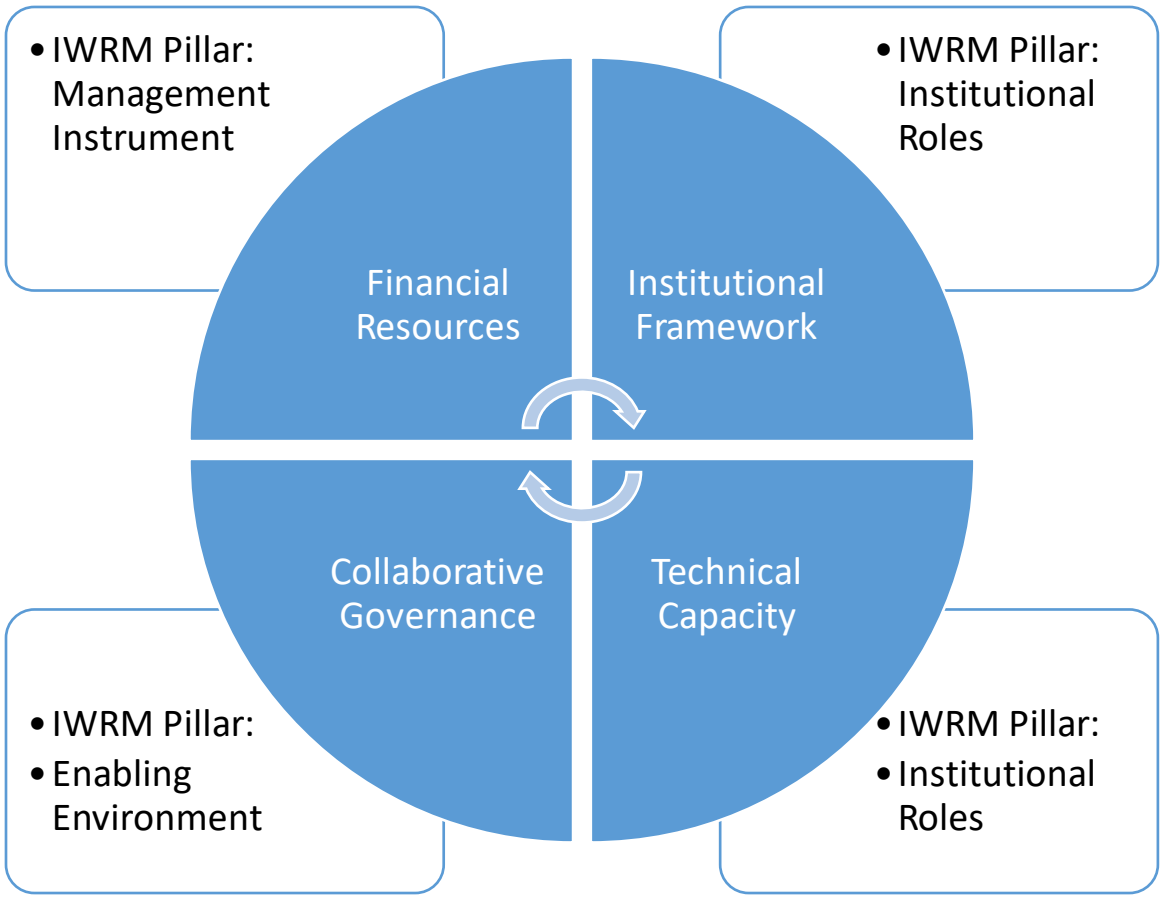

Figure 11. Adaptive Management Learning Cycle.

5.5 Conclusion

The ability to resolve the water challenges of Region 4 Guyana are greatly impacted by the policy gaps. These policy gaps affect the implementation of existing legislation and will therefore negatively impact the implementation of an AIWRM framework for water resources management. Identifying the stresses to the different stages of the policy instrument of the adaptive management cycle allows for a better understanding of the system and increases the possibility of resolving these challenges.

This chapter has discussed the findings of the research and has argued that intervention at the policy instrument stage of the adaptive water management cycle will enable the three pillars of IWRM to be adapted and thus allow for an adaptive integrated water resource management (AIWRM) framework to be implemented in Region 4, Guyana.

Chapter 6

Summary, Conclusions and Recommendations

6.1 Summary

The main objective of this thesis was to analyse the water management framework in Region 4, Guyana, and determine its effectiveness in addressing water challenges in the Region. To achieve this aim, three other objectives needed to be accomplished. Identifying the water challenges of Region 4, and how these are currently being managed was a significant aspect of this research and was therefore given a high level of importance during the semi-structured interview sessions conducted for this thesis. Additionally, understanding the policy and governance issues were necessary to correlate how these might impact the efforts of water resources managers in resolving the Region's water challenges. Identification of the policy gaps were done by analysing the relevant laws that govern water management in Region 4. To evaluate the relationship between water challenges and policy gaps, this research combined the major pillars of integrated water resource management (IWRM) and the learning cycle of adaptive management, resulting in an adaptive integrated water resource management (AIWRM) framework. This case study of Guyana's water management thus contributes to an emerging literature – see, for example, Engle et al. (2011) – that seeks to bring these two processes together as a management option for addressing water policy and governance challenges, such as top-down governance structure and uncertainties increased by climate change. The adaptive management process provides a mechanism for governing water catchments when all the impacts of a chosen management strategy are unknown. And, the IWRM process promotes a more inclusive policy and governance institutional framework for water management at catchment scale. Thus, the resulting AIWRM framework was used as the lens through which the research questions of this thesis were assessed.

The first research question determined how the water challenges in Region 4 are outpacing the current water management laws. These challenges, including flooding, lack of data to inform policy, and a lack of financial resources, are outpacing existing laws because of a lack of both enforcement and a national water policy or regulations to give effect to the current legislation. For example, although there are several laws that govern the management of water resources in Region 4, such as the Water and Sewerage Act, and the Drainage and Irrigation Act, the water challenges of the Region are still not effectively resolved through the enactment of these laws because of the limited capacity (financial or human) of the governing agencies to enforce them. Additionally, the key legislation, the *National Water Policy*, that specifically governs water management, has not been developed to date. Finally, many respondents identified the three main water challenges for Region 4 as lack of financial resources, flooding, and pollution.

The second and third research questions identified gaps in the existing laws and determined if an AIWRM process can be adapted to inform policy and governance strategies. The laws reviewed for this research are more operational than strategic. That is, they outline the high-level management structure for managing the water resource. For example, a lot of detail is given regarding the establishment of the different management boards, and, except for the *Drainage and Irrigation Act*, not much detail is provided for establishing collaboration between stakeholders at the national, regional and local level in the existing laws. Additionally, the laws are outcomes-based with regard to pollution management and water allocation. For example, the *Environmental Protection Act* monitors the effects of projects on the water quality, but does not focus on maintaining or achieving a certain water quality standard by regulating the types of allowed activities. Adoption of the AIWRM policy approach would more effectively address the water challenges in Region 4 directly because the framework is mission-based and does not manage in a

reactive mode, but rather sets aims and objectives for achieving the desired water status among collaborative stakeholders. The AIWRM process will also permit increased collaboration, data collection and sharing, local knowledge to inform policy, and the inclusion of new data into the management strategies as conditions change. Therefore, if a law for water management in Region 4 seeks to address the challenge of groundwater mining, this law will provide details on how to achieve the objective, how to involve multiple stakeholders in the decision-making process, and how to incorporate new knowledge into the management programme. For water management to become sustainable in Region 4, the AIWRM process needs to be applied to inform policy and governance in the Region.

6.2 Conclusions

One of the clearest findings of this research is the problem of coordination and collaboration among various stakeholder groups, particularly with respect to bringing local knowledge into the governance debate. Ostrom and Gardner (1993) work on self-governing irrigation systems suggests a future direction for water management that may be considered. In this study, it was found that by creating networks and trust between the different stakeholders or the users closest to the resource, efficient-use behaviours will develop. Ostrom further established several principles to achieve sustainable management of natural resources at the lowest appropriate level (Ostrom, 1999). One of these principles addresses the issue of boundaries, that is, the roles and responsibilities of the different actors having to be clearly defined. This agrees with the requirements for successful implementation of the AIWRM process; that is, that the roles and responsibilities of the different agencies and water resource managers are clearly defined and that there is no duplication or overlapping of roles (Engle et al., 2011). The other principles presented

by Ostrom (1999) cover the need for collaboration and for the development of policy instruments and monitoring programmes that are specific to the local water body or system under management. Additionally, her principles indicate that any management policy developed for the system should be flexible to change as local conditions change. These principles agree with the principles of the AIWRM process and supports the conclusion that collaborative governance will address the water challenges of Region 4. Firstly, it will reduce the need for large human resources for enforcement, because stakeholders (community members or farmers) will police each other, and therefore closely monitor the effects of their use of the resource on the entire system. Secondly, they will develop a sense of ownership and responsibility, thus allowing the laws to be enforced. This governance approach is all about empowering specific groups of people that are situated in a particular locality. The common ground or value for establishing management for natural resources will allow for sustainable management of the resource (Brunner & Colburn, 2002).

Another finding of this research is that limited data will impact policy development and governance, thereby affecting sustainable management and sustainable development. There is not sufficient data on water quality and quantity of the freshwater resource in Region 4 to develop a profound understanding of the system. This lack of information would therefore affect the ability of water managers to develop the most effective management strategies to address water challenges in the Region. Additionally, what little data do exist is not easily accessible, because the current laws do not provide a mechanism for data storage and sharing between the different stakeholders. For example, any water quality and quantity research conducted by the University of Guyana students and staff should have a mechanism by which valuable information obtained from such research may be included to inform policy design and governance strategies. By making the available information accessible to policy makers or water resource managers, it will help

develop a connection between science, policy and management, thus creating a forum for policy to be informed by the different stakeholders. Establishing such a mechanism will have other benefits, such as increased collaboration and the development of different governance and management levels, because the sharing of information will develop a sense of trust between the different stakeholders. The trust that is established between stakeholders will then result in a greater buy-in and acceptance of proposed policy, instruments and regulations, since these will be agreed upon during the different consultation and collaboration processes and will not be imposed by rules and regulations. This is supported by Jäger (2009), in a study of the connection between policy and sustainable development in Europe, who stated that for sustainable management to occur there needs to be a link or form of communication and data sharing between policy makers, water resource managers and other relevant stakeholders such as water users and scientists.

Finally, the question of institutional adaptability for implementing the AIWRM process is a key concern. Based on this research the initial findings are that an institutional framework is an important aspect for developing sustainable water management strategies, and that it is especially important for the implementation of policy instruments such as economic (penalties for offences) and regulatory policy instruments (pollution discharge and management). Additionally, institutional frameworks should allow for changes to management strategies as additional data to inform these strategies becomes available, thereby creating a policy environment for an AIWRM framework to be implemented. However, this needs further development in another study.

6.3 Policy and governance recommendations

The following recommendations are provided as a guide to improve the AIWRM characteristics of the existing water policy and governance structure in Region 4, and to address the challenges water identified by the respondents.

Recommendation 1: The lack of a national water policy is one of the major challenges to managing the water resources of Region 4, Guyana, though budgetary allocations have recently been made to establish a National Water Council that will develop and then implement such a policy. This thesis finds that the challenges of stakeholder engagement and adequate resourcing of the initiative should be addressed.

How it should be done: the policy design and implementation process should be done with various stakeholder groups across different levels, classes and genders. The water values to be protected and or improved should be derived from these consultations and the appropriate policy instruments that will allow for the protection of these water values should be an output of the consultations with the water users and relevant stakeholders.

Required resources: The resources required to implement this recommendation includes financial resources, the relevant department that will manage and review the design and implementation of the policy, technical staff to guide the policy process and the relevant stakeholders and water users to be involved in the process.

Benefits: This recommendation, if implemented, could offer consistency and coherence in water management from the local level to the national level. It will also address several of the water management challenges of Region 4. Challenges such as the lack of a policy will directly be addressed. The lack of data to inform the policy design challenge will be addressed through the identification of water values to be protected, that can then be operationalized into consistent

variables that can be tracked over time; identification will be done by the relevant stakeholder from the consultations. Should the AIWRM framework be used for the policy design, this should allow for the policy to adapt, in other words, to be more flexible to changing conditions as new information on the state of the Region's water becomes available. It will also allow for the empowerment and commitment of stakeholders and water users at the lower levels, and improve the engagement of all related stakeholders.

Feasibility of implementing recommendation: The financial resources for the establishment of the National Water Council has been made available through the 2017 annual national Budget. This thesis finds that there are sufficient technical human resources available for policy design and implementation. One factor that will limit the possibility of implementing this recommendation, however, is the time it will take to establish the National Water Council, and coordinate the human resources.

Recommendation 2: It is recommended that the water policy framework should allow for management of the water resources on a catchment scale, with the development of a catchment implementation plan allowing for multiple regional and local governance of water resources when appropriate, as catchment hydrologic boundaries might encompass more than one region.

How it should be done: Guyana has three levels of governance: central, regional and local. The ten administrative regions are the regional stage, in which Region 4 is included, and the third stage includes the Regional Democratic Councils, Municipal Councils or the Neighborhood Democratic Councils (2017). The administrative planning to implement water governance at the lowest appropriate scale therefore exists within the regions in the form of the local government. Collaborative water governance strategies should be done, including all three levels of governance. Additionally, technical and, when necessary, financial support should be given to the officials

within the appropriate governance stage to develop and implement the water management strategy for their catchment.

Benefits: This recommendation supports the finding of the need to have governance at the lowest appropriate scale. Examples where this method of governance has been appropriate in Region 4 is the establishment of Water Users Associations under the National Drainage and Irrigation Authority Act, which has seen an improvement of water management at that scale and an increase in compliance, measured by the increase in water rates collection. It could also create jobs within the regions, as water managers will be needed. Finally, this approach will help to address the economic instrument and regulatory instrument policy gaps, because governance at this level with consultations allows for the selection and implementation of appropriate policy instruments that will protect the water values the stakeholders want to protect. It should also be noted that the principle of "lowest appropriate scale" is well established as best practice in environmental policy – see as one example https://www.cbd.int/ecosystem/principles.shtml.

Recommendation 3: Successful implementation of an AIWRM framework for water management in Region 4, Guyana, will require a significant amount of reliable and verifiable data. Until such data become available, it is recommended that management strategies utilise the local knowledge of the catchment along with best practices for pollution control, sanitation, waste management, flood prevention and ecosystem management. This will enable the water resources managers to effectively manage the Region's water resources until the data is available to inform the development and implementation of a comprehensive AIWRM Policy.

6.4 Recommendations for further research

The following recommendations for further research are related to the findings of this thesis in relation to the challenges for water policy and governance in Region 4, Guyana:

Recommendation 1: Lack of a national water policy and lack of data are significant barriers to resolving the water challenges of Region 4. Further research should also seek to obtain data required to inform policy and management decisions. Additionally, research should seek to identify effective ways to determine the state of the Region's water resource. Research should be both academic (full time researcher) and practitioner (professional/workplace) in nature. This could increase collaboration between these two groups and reduce the barriers between scientific knowledge and problem solving in water policy and governance.

How it should be done: Data necessary to inform policy includes, but is not limited to, the quantity of the resource available, the quality of the water resource and an understanding of water supply versus water demand. To obtain this information, research should seek to determine the hydrogeological characterization of the Region's water resources, the geology of the area to identify aquifer boundaries and basic water balance research. Additionally, the establishment of monitoring wells and monitoring stations will provide data about water quality and quantity, and the aquatic ecosystem. For example, the drillers' log data from existing wells can give an estimate for water level and aquifer base. Collaboration between the department responsible for policy development and the University of Guyana and other educational institutions (in the form of scholarships for research) should be considered as a possible method for obtaining the necessary data to inform policy design. A mechanism for the sharing of the data obtained from this research and related works should also be established. It should be the legal responsibility of all partners or stakeholders involved in monitoring, developing or storing the related results or data to make this

information accessible. One or more agencies or departments should be identified as the responsible entity for publishing the data.

Required Resources: Financial resources, technical capacity and appropriate technology is necessary to implement this recommendation. For the sharing of data, this requires an awareness and responsibility of the stakeholders involved in the research to make research results and data available.

Benefits: **S**hould this recommendation be implemented, the base data for water quality and quantity will become available. From this, data monitoring programmes can be developed to inform policies for water management in Region 4, Guyana. It will also address the challenge of human resources (technical research staff), because students from the appropriate educational institutes will assist in obtaining the necessary data via research.

Feasibility of implementing recommendations: The human resources are available within the Region; for example, the University of Guyana has students in the various faculties who can conduct the different aspects of research needed. The main limitation to implementing this recommendation, therefore, is financial resources, because financial resources are needed to establish monitoring wells and monitoring stations. Should students be engaged for conducting the base research, financial resources will be needed to support the different research activities. Finally, time will be another major limitation to implementing this recommendation, because research takes time to be designed and implemented.

Recommendation 2: Lack of communication and ineffective communication methods are barriers to water management in Region 4, Guyana. Research should be done to identify effective ways of improving the delivery of information to water users, and for selecting the best method

for stakeholder consultation, taking into consideration the culture of the stakeholders to be engaged.

How it should be done: A mixture of qualitative and quantitative research should be carried out to gain a better knowledge of the stakeholder preferences and to engage a larger stakeholder population. For example, targeted surveys should be designed and distributed to obtain a better understanding of the different stakeholders and their preferred method of communication.

Required resources: Human and financial resources are needed to implement this recommendation.

Benefits: This recommendation, if implemented, will address the water management challenge of methods of communicating information to stakeholders, by identifying the preferred stakeholder communication method and by identifying the needs, attitudes and expectations of stakeholders. Additionally, water management decisions will be better informed and have a better opportunity of successful policy implementation. This recommendation, if implemented, can also address the challenge of conflicting uses of the water resources.

Feasibility of implementing this recommendation: Implementation of this recommendation should be without any major limitations considering that the social scientist skills required to conduct the proposed research are readily available in Guyana. Limited financial resources to fund the research might impact the possibility of implementing this recommendation.

6.5 Concluding remarks

This thesis has contributed to the literature on combining the integrated water resource management (IWRM) process with the adaptive management (AM) process for natural resources management with the emerging adaptive integrated water resource management (AIWRM)

process as a framework for policy development. Additionally, specific contribution is made to the management of freshwater resources in the context of a developing country, with Region 4, Guyana as the case study.

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Appendix 1- Research Information Sheet

Department: Waterways Centre for Freshwater Management
Telephone: +64 3 0210 872 4896
Email: onika.baptiste@pg.canterbury.ac.nz
29/08/2016

Water Policy and Governance in Guyana, "The Land of Many Waters" Information Sheet

My name is Onika Baptiste; I am currently pursuing a Master of Water Resource Management degree at the University of Canterbury. As a requirement of this program I am conducting research to address water policy and governance challenges in Guyana. My research seeks to analyses the policy problems associated with water management in Guyana.

If you choose to take part in this study, your involvement in this project will be to participate in a semi-structured interview session with the researcher. The interview will be recorded using an OLYMPUS DS-2500 audio recorder. It is estimated that the interview will have a duration of 40 minutes to one hour. Interviews will be done in a professional manner and you will not be required to provide any personal information, except details relating to your professional position and the name of your organization.

As a follow-up to this investigation, you may be asked to provide additional information to clarify any information provided in the first interview session.

In the performance of the tasks and application of the procedures there are risks of you being uncomfortable about being recorded. Should this be the case recording will be stopped at your request.

Participation is voluntary and you have the right to withdraw at any stage without penalty. You may ask for your raw data to be returned to you or destroyed prior to 22/12/2016. If you withdraw, I will remove information relating to you. However, once analysis of raw data begins, it will not be possible to remove the influence of your data on the results.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: your identity will not be made public without your prior consent. To ensure confidentiality, your interview will be coded with a combination letter number code. The data will be accessible by myself and my thesis supervisors. The data will be stored in a password protected computer and will be destroyed after five years as is the policy of the University of Canterbury for Masters research data. A thesis is a public document and will be available through the UC Library.

Please indicate to the researcher on the consent form if you would like to receive a copy of the summary of results of the project.

The project is being carried out as a requirement for the Master of Water Resource Management by Onika Baptiste under the supervision of Amy Fletcher and Bryan Jenkins, who can be contacted at

amy.fletcher@canterbury.ac.nz and bryan.jenkins@canterbury.ac.nz respectively. They will be pleased to discuss any concerns you may have about participation in the project.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

If you agree to participate in the study, you are asked to complete the consent form and return to Onika Baptiste at onika.baptiste@pg.canterbury.ac.nz. Forms can also be returned to Onika Baptiste at the point of contact for the interview.

Appendix 2- Consent Form

Department: Waterways Centre for Freshwater Management
Telephone: +64 3 0210 872 4896
Email:
onika.baptiste@pg.canterbury.ac.nz

Water Policy and Governance in Guyana, "The Land of Many Waters" Consent Form

Include a statement regarding each of the following:

- ☐ I have been given a full explanation of this project and have had the opportunity to ask questions.
- ☐ I understand what is required of me if I agree to take part in the research.
- ☐ I understand that participation is voluntary and I may withdraw at any time without penalty. Withdrawal of participation will also include the withdrawal of any information I have provided should this remain practically achievable.
- ☐ I understand that any information or opinions I provide will be kept confidential to the researcher her thesis supervisors and that any published or reported results will not identify the participants. I understand that a thesis is a public document and will be available through the UC Library.
- ☐ I understand that all data collected for the study will be kept in locked and secure facilities and/or in password protected electronic form and will be destroyed after five years.
- ☐ I understand the risks associated with taking part and how they will be managed.
- ☐ I understand that I can contact the researcher Onika Baptiste at onika.baptiste@pg.canterbury.ac.nz or supervisors Amy Fletcher at amy.fletcher@canterbury.ac.nz and Bryan Jenkins at bryan.jenkins@canterbury.ac.nz for further information. If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz)
- ☐ I would like a summary of the results of the project.
- ☐ By signing below, I agree to participate in this research project.

Name:_____ Signed:_____ Date:_____

Email address *(for report of findings, if applicable)*:

_____

Please return the completed form to Onika Baptiste at onika.baptiste@pg.canterbury.ac.nz

Appendix 3- Human Ethics Approval

HUMAN ETHICS COMMITTEE
Secretary, Rebecca Robinson
Telephone: +64 03 369 4588, Extn 94588
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2016/66/LR

14 December 2016

Onika Melissa Baptiste

Waterways Centre For Freshwater Management

UNIVERSITY OF CANTERBURY

Dear Onika

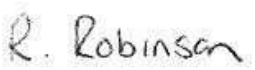
Thank you for submitting your low risk application to the Human Ethics Committee for the research proposal titled "Water Policy and Governance in Guyana, "The Land of Many Waters"".

I am pleased to advise that the application has been reviewed and approved.

Please note that this approval is subject to the incorporation of the amendments you have provided in your emails of 29th November and 9th December 2016.

With best wishes for your project.

Yours sincerely

pp. 

Jane Maidment

Chair, Human Ethics Committee

University of Canterbury Private Bag 4800, Christchurch 8140, New Zealand. **www.canterbury.ac.nz**

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